The Utilisation of Spatial Planning in Improving Urban Water Culture: A Case Study of Oranjezicht, Cape Town

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Abstract

Nothing can exist, live, survive or thrive without water. Water is the basis of life for all living organisms and the centre of life for all societies. The global attitude around water has become territorial as it encompasses an intricate link to the development of nations. Centralising main water supplies beyond urban boundaries may have improved the utilisation of water but has also resulted in the separation of society and water.

Water is what gave rise to the city of Cape Town, as there was an abundance of rivers and springs located on and around Table Mountain. This water was first used by the Khoi people and became the reason for colonial settlers residing in the Cape. The City is currently experiencing the worst water crisis in over a century due to increased temperatures and decreased rainfall. Amid the water crisis there appears to be underused, freshwater below Cape Town's CBD, flowing to the Atlantic Ocean via the stormwater reticulation system. This water originates from Table Mountain's rivers, streams and, to an extent, springs.

Naturally, the drought has sparked widespread concern for, and attention given to, water and its sustainable usage. This dissertation explores the ways in which the City's water, environmental and spatial planning policies could spark a new and improved water-culture within Cape Town to ensure sustainable, long-term water availability. This is done through investigating the potential of Oranjezicht in becoming a catalytic area for water sustainability due to the locations of the Field of Springs and the Platteklip Stream. This dissertation proposes using water sensitive urban design as well as integrated, collaborative partnerships and management mechanisms to encourage an improved urban water culture.

Contents

Abbreviations and Acronyms

City – Local Government i.e. The Municipality

city – The physical/geographical area of Cape Town

CoCT – City of Cape Town

CRS - Camissa River System

CTMSDF – Cape Town Metropolitan SDF

DSDP – District Spatial Development Plan

IDP – Integrated Development Plan

IUWM – Integrated Urban Water Management

IWM – Integrated Water Management

IWRM – Integrated Water Resource Management

LUPA – Land Use Planning Act

MSA – Municipal Systems Act

NDP – National Development Plan

NFSD – National Framework for Sustainable Development

NSSD – National Strategy for Sustainable Development

NWA – National Water Act

NSSD – National Strategy for Sustainable Development

NWA – National Water Act

NWRS – National Water Resource Strategy

SDF – Spatial Development Framework

TDA – Transport & Urban Development Authority

WCED – World Commission on Education and Development

WSDP – Water Services Development Plan

WSUD – Water Sensitive Urban Design

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Chapter 1

1 Introduction

1.1 Context and Purpose of the Study

Freshwater may not seem like an obvious issue within Cape Town however, this has been changing in recent years. The city of Cape Town is currently going through one of its worst water crises in the last century (de Lille, 2017). In fact, the Western Cape of South Africa faces strict water shortages due to minimal rainfall and a growing population. The purpose of this study is therefore to improve the socio-water relationship and encourage a new and improved water-culture within Cape Town. The goal of having an improved water-culture is to encourage more sustainable and less wasteful attitude towards water as it is rapidly becoming a scarce resource.

The city of Cape Town is in the south-western part of South Africa known as the Western Cape (Figure 1.1). Cape Town is characterised by having a typically Mediterranean climate containing cold, wet winters and hot, dry summers (van der Velden, nd). The city is situated in a narrow winter rainfall region and is surrounded by mountain ranges separating it from the Western Cape's semi-arid region (Joubert, Stewart & Eberhard, 2003).

South Africa typically experiences extreme weather events, such as periods of heavy rainfall leading to flooding and periods of drought, as part of the natural climate variability phenomena (Wright, Engelbrecht & Sweijd, 2015). However, the rate at which global warming is occurring, as well as the stark contrasts in climate variability patterns, indicate negative anthropological influence. For instance, 2015 has been recorded as South Africa's warmest year in the last 150 years (ibid) and during the period from 2015 to 2016 the country has experienced one of its worst droughts (Dippenaar, 2016). While the droughts are in large part due to the long-term, natural climatic cycles and the El Nino phenomena, the anthropological impacts are exacerbating these natural cycles (ibid). This results in intensely negative impacts on the natural environment and society.

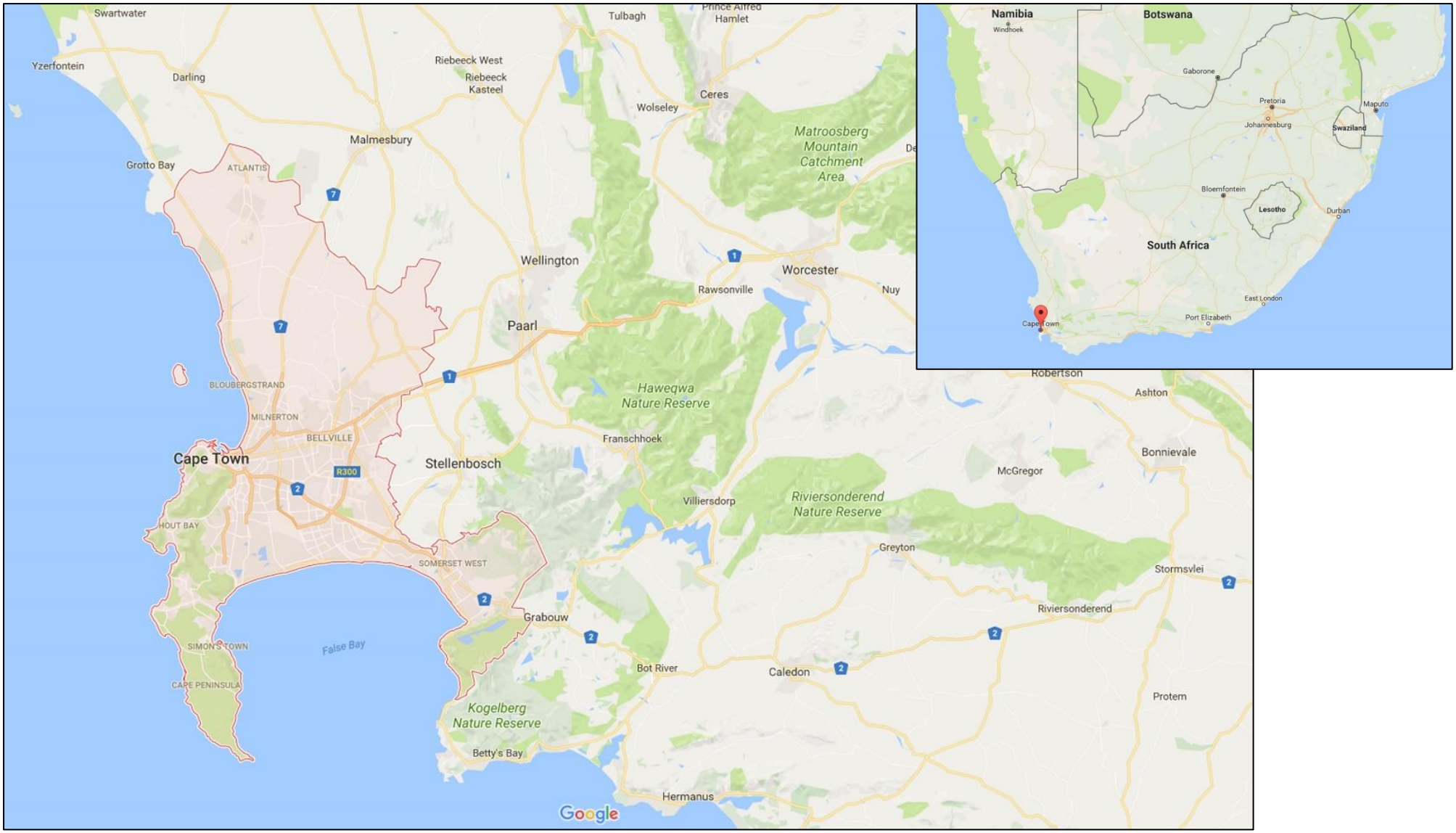

Figure 1.1: Showing the location of Cape Town, Western Cape

The water crisis in the Western Cape has been persistent for, no less than the past two years. Level two water restrictions were put into place during December 2015 and said to be implemented in January 2016 ("Strict water use rules for Cape", 2015) and as of September 2017, the city faces level five water restrictions. Level two restrictions were implemented to attempt to save at least 20% of the Western Cape's water, as Cape Town's dam levels were 15% below the standard level during the summer period (ibid). Level five restrictions were implemented due to scarce rainfall during the Cape's winter season and fast declining dam levels (City of Cape Town, 2017). According to Bohatch (2017), the exacerbating effects of Cape Town's water crisis could be attributed to a population growing faster than the city's storage capacity; the possibility of high levels of water consumption before the drought and lastly, the effects of human-induced climate change and global warming. The conditions of water in the Western Cape impacts the city of Cape Town as the major dams supplying the city are located beyond the borders of the metropolitan region. The city's major dams include Theewaterskloof, Voëlvlei, Berg River, Wemmershoek, and the Steenbras Upper and Lower dams, located in Villiersdorp, Gouda, Franschoek and Grabou respectively, see Figure 1.2 (City of Cape Town, 2017).

According to the State of Cape Town Report (2016), the condition of rivers and inland water bodies needs drastic improvements, as many are currently contaminated sources of water. These polluted water sources are largely a result of poor living conditions which has then led to pollution. The state of Cape Town's rivers therefore alludes to the need for increased water-consciousness. The Camissa River System (CRS), flowing down the face of Table Mountain was one of the city's key water sources as it gave rise to its establishment (von Zeil, 2011). This dissertation highlights the potential of a portion of the CRS, more specifically the upper portions of the Platteklip Stream, in improving water-consciousness within Oranjezicht and a portion of Vredehoek (see Figure 1.3). If done appropriately, the newfound water-consciousness could spread to the general city region through inspiring innovative projects.

Figure 1.2: Showing the location of Cape Town's main supply dams in relation to Cape Town Metropolitan Region (Google Maps, 2017)

Figure 1.3: Showing the suburbs within the study area (UCT GIS Data, 2015).

1.2 Historical Overview

The CRS was the reason for Cape Town being known for its abundance of water sources, leading to European settlers inhabiting the Cape. This later resulted in the colonisation of the land, water and people of the Cape. After the establishment of European settlers, the Khoi people became excluded from certain land and resources in what is now Cape Town's central business district (CBD). It was under European rule that the deepening and engineering of the main Camissa River was executed, which was done because of the increasing population growth (Brown & Magoba, 2009). Over time, the constructed canals became polluted and the need for larger water sources and storage arose. It was around 170 years ago, under British rule, that the canals were built closed and as a result, the tunnels were created (Head, 2017). This was also around the time of the construction of Cape Town's minor dams, such as the Woodhead, Hely-Hutchinson, Victoria, Alexandra and de Villiers dams.

1.3 Purpose of the Study

The tunnels that once carried polluted water to the ocean still exist below Cape Town's CBD. These tunnels now carry fresh, spring water to the ocean with most of the water being wasted ("Reclaim Camissa", 2013). Historically Cape Town had approximately 4 rivers and 36 springs flowing from the mountainous slopes (ibid). This therefore highlights the fact that there is great potential for the future development of Cape Town to become a leading water sensitive city. To achieve this, water can no longer be considered as a product and resource for human utilisation, consumption and transportation of effluent but rather another stakeholder in the city.

The purpose of this study is to investigate the potential of the Platteklip and Stream, in improving the anthropological consciousness through the implementation of blue-green infrastructural mechanisms to be more inclusive of water and improve water-cognizance. It also encourages improved management of water and water resources by citizens and governmental officials. The lack of rainfall in Cape Town in recent

years indicates an urgent need to become a water sensitive city. The neglect of water sources within the city can be attributed to past inequalities suffered under the apartheid regime. This is evident in the fact that pressing needs such as housing and unemployment are often seen as a priority over environmental concerns (Schäffler & Swilling, 2013). However, there needs to be a more socio-environmental approach to the current water concerns in Cape Town. More recently, it has been stated that Cape Town's leafy suburbs consumes more water than the other sectors due to the maintenance of lush gardens and filling of pools (Nicolson, 2017). This highlights the need to improve the water-relationship within high-income areas as well as encourage the usage of water sensitive urban design (WSUD) technologies within private and public spaces.

1.4 Ethical Position

As stated by Rabkin (2013), planning is a discipline which is strongly underpinned by one's personal values. It is therefore important for planners to state their ethical position upfront to understand the purpose of the project interventions.

This research project stemmed from my interest in the built environment and socio-environmental spatial injustice. My background in Environmental and Geographical Sciences, Sociology and more recently, urban planning has highlighted the importance of addressing spatial injustices, especially within the current social and physical climates of Cape Town, South Africa. The social climate within Cape Town and South Africa is one of persistent injustice because of former political regimes (CoCT, 2012). The physical climate refers to changing climatic conditions, more extreme weather conditions are likely to exacerbate current injustices through the further victimisation of the poor (Mirza, 2003). South African history shows that environmental injustice has been perpetuated through limited access to land and resources (Brown & Magobo 2009; McDonald, 2004). The intersection of social, environmental and now, climate injustices has manifested in the layout of South African cities.

The aim of this research project is therefore to reconnect people with the natural environment, more specifically with water, considering the increasingly dry conditions within Cape Town.

Having sections of the CRS flow in a concrete sleeve beneath Cape Town's CBD is a key environmental and social injustice as it inhibits the relationship between people and water within the study area. This is especially unjust during a period of continuous water crises and mismanagement of waterways. In addition to the CRS, the Liesbeek River, Black River and Cape Flats Aquifer are water sources, within the metropole, which are not being recognised and used to their full potential with the latter three being heavily polluted (CoCT, 2012; Adelana & Xu, 2006). The key ethical position of this dissertation is having water recognised as a stakeholder in the city of Cape Town and making it available to all residents. This will emphasise the importance of spatial water-relationships.

As stated by Transport for Cape Town (City of Cape Town, 2009) a well-managed watercourse can improve the quality of life and aesthetic value of an urban area. The City of Cape Town has grown and developed around various water sources originating from Table Mountain, with a CBD developing in its flow path. The reason behind the selection of the water flowing from Table Mountain is that the city centre is the area that is used and enjoyed by a wide variety of citizens and visitors. The spring and river water flowing form Table Mountain also flows within high-income neighbourhoods such as Oranjezicht and Vredehoek. This emphasises the responsibility of such neighbourhoods to draw attention to natural resources in a way which benefits all users of the space. Consequently, having the potential to expose and celebrate new, diverse water cultures and relationships. This must be done to create a new conversation around water and water sustainability and to redress past inequalities.

1.5 Scope of Study

Nothing can exist, live, survive or thrive without water. Water is the basis of life for all organisms, which is why it must be protected and cared for. Given Cape Town's current water crisis and the potential permanent drought, the reason for undertaking this research is not only to explore the possibility of reviving these historical water sources but also rather to rejuvenate and revitalise the water sources and anthropogenic culture and attitudes around this scarce resource and fundamental element of life. This dissertation is therefore limited to the scope of environmental and social water-consciousness and its role in spatial planning. To holistically address the issue of urban

water scarcity, inter-disciplinary, strategic solutions are encouraged to cater for diverse communities. Strategic spatial planning has the potential to fulfil this role in the following ways:

- Contribute to research and analysis of current water trends.
- Strategic thinking to ensure wise, prioritised water utilisation and consciousness.
- Inter-disciplinary solutions to ensure the best aspects of various disciplines are incorporated in the various interventions.
- Policy analysis and recommendations could lead to innovative policy formation and practice.
- By enabling spatial requirements for water sensitive approaches and design.

Therefore, this dissertation aims to use the elements of spatial planning to unlock the potential of Cape Town's historic water sources, specifically the Platteklip Stream. The broader context such as the CBD and the inner city mixed income areas, will also be considered (Figure 1.3). As can be seen in Figure 1.4, the study area is where a portion of the CRS enters the city. For this dissertation, the name Oranjezicht will be used for the site under study, unless stated otherwise.

Figure 1.4: The study area and the key water elements under investigation (UCT GIS data, 2015).

1.6 Methodology

This section looks at the research questions, methods and techniques that will be employed in this dissertation. This research could potentially provide a theoretical base for research into the improvement of socio-water relationships. It relies on the possibility of the revival of a historically significant water system to improve anthropological water behaviour. It also encourages sustainable water usage in response to Cape Town's changing climate. The focus area of this research is a suburb within Cape Town's CBD, which serves as a small-scale intervention project with potential to expand beyond the suburb boundaries.

The key method used in this research is the case study method, along with aspects of other methodologies. This section sets out the central and subsidiary research questions and discusses the research methods and techniques.

1.6.1 Research Questions

Central Questions to be Investigated:

Based on these assertions, I first need to ask:

- How can spatial planning enable and support a more water sensitive city, in terms of relationships, attitudes and practices within Oranjezicht?

If the claims made by various scholars are valid, then I need to ask:

- How can spatial planning contribute to the revival and restoration of historic water sources beyond the boundary of Oranjezicht?

Subsidiary Research Questions

- How could spatial planning strategically reshape and improve Oranjezicht's relationship with water?
- What channels does the field of spatial planning have, to cater for the reverence of historic water sources in Oranjezicht?
- How could spatial planning policy positively influence and/or prevent the wasting of the natural spring and river water?

- How can spatial planning make a valuable contribution, which allows the Platteklip Stream headwaters to benefit civil society, public and private sectors?
- How would this research contribute to the existing environmental spatial planning research in Cape Town?

1.6.2 Research Methods

Research methodologies refer to the means and processes of gathering information and data to be examined and interpreted. Research methods are typically either qualitative or quantitative; the former consists of a researcher describing the characteristics of people or events (Thomas, 2003). It is typically used when attempting to understand reasons, opinions and motivations therefore being more subjective. The latter is used when analysing measurements and amounts related to the above-mentioned characteristics and events (ibid). The numerical data contributes to statistical information hence being a more objective, meticulous research method. The methods used for conducting this research will be the case study method, discourse analysis and archival research. Once the data has been collected, a mixed methods approach will be employed to analyse and interpret it.

1.6.2.1 Case Studies

The case study method allows one to produce context-dependent value-driven knowledge, making it specific to one area (Flyvbjerg, 2011). This research is focussed on Oranjezicht and analyses the potential for sustainable water-centred projects in addressing current water behaviour. This method is ideally suited to gaining in-depth information about a specific site. Using this method allows for a comparison between case-specific findings (i.e. the local anthropological water relationship) and global thought around water and the ways in which it is cared for.

As stated by Yin (1994) there is flexibility in the case study method as the number of cases and units of analysis are entirely dependent on the research. This method does not require research to be either quantitative or qualitative (Rabkin, 2013). This has allowed me to research the spatial planning implications for qualitative water usage within one suburb, containing different natural sources of water. Disadvantages of this method include difficulty to draw

generalisations and it is inclined toward supporting the researcher's views.

1.6.2.2 Discourse Analysis

This research method is typically used when analysing written and verbal texts to better understand theoretical and policy frameworks. This type of analysis is important to the research of Cape Town's historical water sources as historical documents, local and international theories and policy documents will need to be analysed and interpreted.

1.6.2.3 Archival Research

This type of research is used when seeking information from archival records from either primary or secondary sources. This methodology will be used when accessing pre-colonial and colonial maps and writings.

1.6.3 Research Techniques

1.6.3.1 Interviews

This technique provides an opportunity to gain in-depth knowledge from personal experience. It could also be a way for the interviewer and interviewee to create meaning based on one's experience. This research necessitates semi-structured interviews and dialogues with policy makers, private consultants, members of civil society, residents, academics and other stakeholders concerned with the redevelopment of Oranjezicht and its water relationships. Semi-structured interviews might be less restricting for both parties and allow for discussions opinions concerning the drought in Cape Town and the relative policies. The advantages of this methodology are that it is flexible and allows for personal insights thereby building trust; it allows one to gain deeper insights and insert it into the study.

1.6.3.2 Desktop Study

This technique will be used to review literature, understand various theoretical stances, analyse and interpret existing policies and to undertake parts of the archival research. A key advantage of this

technique is that large amounts of information can be accessed easily at virtually no cost.

1.7 Ethical Considerations

It is vital to be aware of the existing and potential ethical issues and to use information thoughtfully, responsibly and with integrity. The aim throughout this dissertation process is to engage in ethical research by requesting permission to use excerpts of the interviews and maintaining confidentiality when requested. It is important to note that each researcher will hold personal bias, hence relating to the importance of positioning oneself about the issues discussed.

1.8 Limitations of Research

The limitations of this research include the time constraint of having the all aspects of this dissertation completed in approximately four months, which limits the depth and breadth of the study. Because of limited accessible and current information on the headwater of the Platteklip Stream and Oranjezicht, the study required primary research to be done in the timeframe of a secondary research project. This project therefore relied on secondary data sources.

A community participation process would have been ideal to include in this research to gain a better understanding of current, local water-relationships within Oranjezicht.

1.9 Structure of Dissertation

This dissertation is structured by a means of a series of chapters, which aim to address the primary and subsidiary research questions. This introduction chapter will be followed by a literature review, which aims to understand the local and global aspects of securing water through innovative spatial planning, by means of studying water and environmental sustainability, integrated water resource management and WSUD. The literature review is an exploration of the relationship between spatial planning and global water management practices. It explores the ideas, gaps, inspiration, opportunities and critiques of such systems.

Chapter three is a contextual analysis which contains a detailed analysis of Oranjezicht, the Platteklip and Sliver Streams and the Field

of Springs. This chapter starts with a historical analysis of the site and moves into an analysis of the site's historical water politics. A spatial analysis of the site is then conducted containing socio-economic, biophysical, infrastructure and heritage analyses. The chapter then moves on to discuss the relevant legislation, policies and institutional arrangements. Lastly, opportunities and constraints are identified for informing the interventions of chapter four.

Chapter four contains the proposed interventions based on the findings of chapter three. This chapter starts by identifying the vision, aims, objectives and strategies for the proposed interventions. It then proposes spatial and policy interventions which could lead to the improvement of Oranjezicht's water-culture.

Chapter five summarises the processes needed to achieve successful implementation of the proposed interventions. This includes the actors, timeframes and strategic project phasing.

Chapter six, the concluding chapter, contains a summary of the dissertation, recommendations for future research and project reflections.

Chapter 2

2 Literature Review

2.1 Introduction

As stated by the United Nation's (UN's) Water Decade Programme on Advocacy and Communication (2012), water is a finite resource and is only renewable if sustained with care. Hence, making strategic water management a pre-condition to sustainable development.

As of 2008, 50% of the global population lived in urban settlements (UN, 2012). Over the following eight years, this number has increased to 54.5% of the global population living in urban areas, and is projected to be 60% by the year 2030 (UN, 2016). These international statistics provide an indicator of the rate at which population growth and development is taking place, having implicit effect on water. This rapid growth and change also highlights the fact that the past can no longer be relied upon to inform the future of water and cities. Water is needed in every aspect of human and ecological life and therefore plays a vital role in future development.

The purpose of this literature review is to situate the possibility of an improved urban water culture within international academic and practical debates and discourses. This review focuses on the global thought around water which has been, and is increasingly its management. The approach taken is one of social and environmental justice and future sustainability. This links to the aim of this chapter, which is the prioritisation of social and environmental sustainability through urban planning mechanisms. This review looks at literature relating to sustainable development and water management in urban areas, to formulate ideas around the transformation towards sustainable urban water planning.

This review contains five key sections, beginning with a discussion on sustainable development in relation to water. Secondly, it notes the current global water challenges within urban environments. The third section contains a discussion around urban water planning and its management. The review then considers the role of spatial planning in water management and, lastly, the review identifies green infrastructure and water sensitive urban design (WSUD) as key elements of urban water management.

2.2 Overview of Sustainable Development

The idea of progress has always been prevalent in human societies given that the increase in knowledge and power is a natural part of human behaviour. According to Bury (1932), progress is defined as the movement of civilisations towards a desirable state. To move toward a desirable state, it is important that society is aware of the destination (Bury, 1932). The outcome of a desirable state for any rational person or society would be to lead a fulfilling life (ibid). Although this is ultimately the goal in the field of spatial planning, it poses a key challenge due to its subjectivity. The idea of a desirable state therefore brings up many debates and discourses due to the diverse range of morals and values of different groups of people, which goes beyond the scope of this discussion. However, it highlights the need for planners to be honest about their ethical positions. For this discussion, the terms 'progress' and 'development' are used interchangeably and defined as the gradual betterment of human life over time (Merriam-Webster, 2017).

During the pre-modern era, the notion of progress grew from religious teachings, where great emphasis was placed on the importance of achieving spiritual perfection (Du Pisani, 2006). In practice, the concept took on this religious perspective and was viewed as the attainment of spirituality for the next life, which also included utopian ideals (ibid). By the 13th century, European ideals of progress had been established as the advancement of culture and belief in a future golden age of morality (ibid). This led to the idea that western modernity and progress are synonymous (ibid).

It was during the 18th century, at the unfolding of the industrial revolution, when the idea of progress turned to economic development. This lead to the rapid transformation of natural resources into products or *things* for consumers (Du Pisani, 2006). There was also hope that technological and scientific advancements could lead to the moral progress of humankind (ibid). This was the beginning of the shift in meaning of the concept of development, from a divine path of sacrifice in this life for a better afterlife toward a more materially oriented life (ibid).

Historically, the relationship between people and the natural environment has been one of relative consciousness due to the need for natural resources (Du Pisani, 2006). The change in direction of the development discourse along with the system of capitalism fostered unequal growth between industrialised and unindustrialised nations, as well as the flourishing of humankind at the expense of the natural environment. This also conditioned the thinking around humans as a separate entity to the natural environment. Hence leading to escalating concerns about sustainability and sustainable development.

According to Du Pisani (2006), concerns about sustainable development are nothing new. Concerns around environmental degradation have existed since the 1st century BC when issues resulting from human activity were discussed and improved practices were recommended to maintain the state of the land (Du Pisani, 2006). By the 18th century, because of the fear of running out of the natural resources needed for construction, new ideas were formed around sustainable environmental practices (ibid). The ideas formed during this period are like current thoughts on sustainable development, in that resources were to be used in a way to ensure future supply (ibid). From the literature explored, the shift towards the discussion of sustainable practices seems to have been done to maintain a contented standard of living at the time.

The 20th century consisted of pessimistic and optimistic moments during the process of redefining the idea of progress (Du Pisani, 2006). This era is characterised by the Great Depression, the Golden Age of Capitalism and the start of global environmental consciousness. These economic characteristics were a result of the development of the now developed nations of the west (ibid). The post-World War II economic boom simultaneously raised living standards in the west, and to an extent compromised the state of the natural environment (ibid). This then led to a change in the discourse of sustainability and sustainable development during the 1980s (ibid).

The concept of sustainable development came to light during the 1980s at a time of widespread development and impending environmental crises. The concept became a feature of academic and practical discourse when mentioned in the 1989 Brundtland Report

for the World Commission on Education and Development (WCED). Sustainable development is commonly seen as development that provides benefits to all sectors, mitigating possible negative impacts. This changed the way development was seen, and changed local and global policies from economic–centred to a more holistic one which considers both the natural environment and future generations.

"*Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*." (WCED, 1989: Section 1 The Global Challenge)

The report further states that poverty is avoidable and that it can be overcome through providing opportunities for an improved future for all people, along with more modest living by society in general (WCED, 1989). The need for an improved future for the natural environment is also emphasised in that, the concept of sustainable development as defined in this report, implies limits (ibid). The report argues for limited development to ensure living within the Earth's ecological means, having special relevance in the context of developed nations. Essentially, development is to be rationed due to the ecological limits placed on human progress and expansion (ibid).

2.2.1 Sustainable Water Development and its Frameworks

The concept of sustainability has become strongly intertwined with water and water management due to its importance to human development. As identified through the literature reviewed, water management has become increasingly tied to the concept of sustainability due to rapid human development. At the same time, the concept of sustainability engages with the failure of 20th century development practices in that the natural environment is not acknowledged as strongly as it should be. For instance, the 20th century has been characterised by the large-scale construction of water infrastructure such as dams and pipelines to meet human needs (Gleick, 2003). This resulted in water management systems leading into the realm of water innovation. Water planners have therefore been more focussed on the supply and demand of the resource and less focussed on ecologically sound water innovation (ibid).

Widely accepted and practiced ideas regarding water in sustainable development are mainly linked to the management of water and water systems. As such, the discourses of Integrated Water Resource Management (IWRM) and Integrated Urban Water Management (IUWM) (which stemmed from Integrated Water Management [IWM]) have been developed. A common understanding among urban water planning practitioners from the late 20th to 21st centuries is that the IWRM approach is needed to practice sustainable development.

More recently, there has been a growing amount of literature supporting soft infrastructural approaches towards water. This could also be a result of more recognition being given to cultural and spiritual ideals around water. For instance, Bonelli, Roca-Servat and De Mesquita (2016) discuss the ways in which indigenous American societies view water and its benefits. One such viewpoint is as follows:

> *we protect the relatives that we have, and those relatives are the plant life, the animal life, the water. We don't think about them as resources, we think of them as actual beings that are precious to us, and its indigenous peoples who share that.* (Bonelli, Roca-Servat and De Mesquita 2016:2).

The implications for urban planners include a greater consideration for water and other aspects of the natural and social environments through innovative policies, which also encourages holistic management of ecological and natural heritage. The different paradigms of water identify the thoughts and perceptions of water, guiding its management over time.

2.2.2 The Eight Paradigms of Water

Hassan (2011) lists nine water paradigms beginning with the spiritual-religious paradigm which is deeply rooted in a spiritual connection to water and water bodies. The standards linked to spiritual-religious systems of belief are often, but not exclusively, maintained by indigenous peoples and religious groups. The second paradigm is the aesthetic-recreational paradigm that highlights the need for water in a non-utilitarian way, i.e. through revitalisation and reflection (Hassan, 2011). Thirdly, the scientific paradigm began during the 19th century and was a result of the discovery of water borne diseases

(ibid). This approach led to many scientific discoveries and started the emergence of the scientific paradigm (ibid).

Water technologies have existed from approximately 8600 years ago, in the form of wells, canals, dams and drains (Hassan, 2011). It was with the emergence of turbines and hydropower plants that the fourth paradigm of hydraulic engineering began (ibid).

The fifth paradigm, economic-financial, recognises water as an economic asset hence supporting its privatisation (ibid). Attaching a monetary value to a fundamental human right, in this case, is a form of conservation and wastage prevention. Both the economic and engineering paradigms existed during the late 20th century and developed because of the industrial age and the need for rapid economic growth.

The rapid growth of urban areas in the west resulted in resource exploitation across many countries. The period of rapid economic development has resulted in ecological disasters across the globe. Hence, leading to rapid consciousness and the creation of socio-environmental movements, which formed part of the sixth paradigm (Hassan, 2011). The ecological paradigm recognises water as an essential part of all life-supporting systems as opposed to utilitarian views that were popular at the time.

The seventh paradigm resulted from the increase in demand for water by a variety of users (ibid). As is the case with resources in high demand, the need arose for national governments and international institutions to manage it and led to the managerial-governance paradigm (ibid).

Finally, the legal-ethical paradigm is concerned with the issues of water rights and governance (ibid). Early societies were also concerned with aspects of water law and rights although this took the form of ethics and religious beliefs, and were often social norms (ibid). This paradigm should be based on the ethics of societies within the respective contexts, and should inform civic law.

Although these paradigms developed at different times throughout world history, we are currently living in a time where these paradigms

intersect and inform the global ethic around water. All these paradigms fit into the ideas around sustainable water development. It is important for built environment professionals to analyse and manage the supply and demand aspects of water, for practical reasons. However, we are living at a time where sustainable solutions are vital due to social and ecological concerns. The wide variety of different norms calls for innovative spatial planning interventions to draw attention to different relationships with water, which then influence water planning and management.

2.3 Global Challenges

This framework was developed in response to several global challenges, contributing to the availability of fresh water. An increasing amount of countries are struggling to cope with economic and social development due to rapidly increasing population growth and depleted resources, which is quickly becoming a water issue (GWP, 2000). The increased economic activity and improved standards of living have led to intense competition and conflicts over land resources and fresh water, which is happening mainly in developing countries (ibid). The challenges facing global water resource management are social, environmental, political and economic.

In addressing the social aspect of global water challenges, it is important to bear in mind that water is not purely for human consumption or for human development; there is also a need to mend and restore the human-water relationship. As stated by Rahaman and Varis (2005:20), "*Water is the common symbol of humanity, social equity and justice*", it is the way people connect with the world, on spiritual and cultural levels. Consequently, its access encourages quality of life and social responsibility.

As stated by the GWP (2000) improved water dealings are needed to secure water for the human population, for food production and the creation of employment opportunities. The right to clean, safe, accessible drinking water is a human right, yet at least 2 billion people use contaminated water sources for consumption and by 2025 an estimated 50% of the global population will be living under water scarce conditions (WHO, 2017). In the food production industry,

agriculture uses 38% of the global freshwater and produces 32% of its wastewater (WWAP, 2017). This emphasises the need to re-use wastewater to improve the value per drop (WHO, 2017). The reduction in human water usage through re-use and recycling allows the natural environment to receive increased benefits.

Within international reports, the environmental water challenges include the protection of vital ecosystems for the benefit of human and environmental systems. The headwater allows for rainwater infiltration and groundwater recharge but is negatively affected by the construction of dams (GWP, 2000; Rahaman & Varis, 2005). Whereas the lowland areas are mostly affected by the channelization of rivers (Rahaman & Varis, 2005). In many riverine systems, the hydrological connectivity between the river source and its floodplain is limited to the more restricted, groundwater flow. This is a result of damming or channelizing rivers (ibid). Migration patterns and aquatic life with its various ecosystems are thus negatively affected.

Allowing water to be considered an economic good, poses a risk to the social interactions around water. The commodification of water shifts the public perception away from water as a common good and shared responsibility (Rahaman & Varis, 2005). Hence making the human-water relationship a selfish one as it encourages ownership on the individual level. Generally, water seems to be recognised as an economic good before a human right since in many developing and poverty-stricken countries, water is not subsidised (ibid). Having water treated as a market commodity on a domestic level is an injustice to already impoverished nations.

In terms of industry, the economic threat faced by the global water challenge includes the loss of natural resources needed for production (GWP, 2000). Threats to water resources would also change the nature of investments made in the development of cities and countries (GWP, 2000). As mentioned by Rahaman and Varis (2005) the privatisation of water and water sources are also a threat to water-justice and forms part of the global water challenge. Privatisation may encourage fragmentation on political and social levels as it discourages subsidised water provision and could result in single-purpose planning and management (Rahaman & Varis, 2005). Hence, leading to questionable transparency and information channels.

The political threat underlying the global water challenge lies in the management of water resources. Globally, there is great difficulty in enforcing inter-sectoral river basin plans, challenges include lack of local participation, absence of formal agreements on international water allocations, varying limits on pollution and military power imbalances (Rahaman & Varis, 2005). It is vital that water resources are taken care of in an integrated way, encouraging collaboration between sectors and across political boundaries (ibid). However, this would likely require direct international negotiations, as there is no legislation guiding the sharing of internationally shared water resources (Koudstaal, Rijsberman, Savenije, 1992).

It is also important to create public awareness and understanding to gain effective support in the care for water resources. Mass support and social mobilisation will gain political attention and encourage political mobilisation (GWP, 2000). Rahaman & Varis (2005:19) eloquently emphasise a socio-political positive view of water management: "*Water should be recognised as a tool for community development, peace-building and preventative diplomacy*". With the needed trans-boundary care for river basins, water has the potential to unite conflicting interests and facilitate agreements among societies.

From the year 2008 onwards, more than 50% of the global population are said to reside in urban areas (Population Reference Bureau, 2016). This poses a huge burden on urban environments to provide for an increasing population. The ways in which urban environments have been constructed and the expectations it presents, leaves little room for consideration of the natural environment. As stated by Rabkin (2013), the concept of sustainable development has been around and active in the political sphere for nearly three decades, yet there is still widespread poverty and socio-ecological injustice. Water scarcity is a key problem, especially in developing nations with causes linked to social, economic and political issues. In recent history, the impacts of climate change on freshwater sources are said to worsen in already undesirable circumstances. As stated by the UN (2015), water scarcity affects up to 40% of people and is expected to increase as effects of climate change get worse. Developing nations' livelihoods are directly connected to the natural environment, more so than that of developed nations. This increases their level of vulnerability with environmental degradation and global climate

change (UN, 2015). This creates a need for new kinds of sustainable development and urban planning or, alternatively, a substitute to development as it is known today (Matthews, 2004).

2.4 Urban Water Planning and Management

Urban water planning is not a new concept as its importance was already highlighted during the 1970s. As stated by Schneider, Rickert and Spieker (1973) urban water planning became an important aspect of urban planning with the increase in urbanisation. This put more pressure on water sources and the natural environment in general, which led to the increase in socio-ecological concerns (ibid). The primary role of urban planners is to guide urban expansion and its future development to minimise problems and enhance the quality of life of living organisms (ibid).

The 20th century is characterised by engineering projects attempting to bridge the gap between the natural and urban environments (Gleick, 2003; Schneider, Rickert & Spieker, 1973). For instance, to meet the water needs of urban populations, infrastructural projects such as the construction of dams and pipelines were implemented (ibid). As was the case in the United States, these projects often took place far beyond city boundaries and what was intended as convenient development, ended up interfering with the human-nature relationship (ibid). Hidden water infrastructure (i.e. underground pipes) and distant water sources can be seen contributing to viewpoints which detach humans and nature. However, as the human-centred approach to development and large-scale depletion of natural resources normalised, the awareness around both ecological and social concerns increased.

The change in attitude towards the human-nature relationship came because of environmental and ecological degradation, which eventually highlighted the interdependence between social and ecological environments (Schneider, Rickert & Spieker, 1973).

As freshwater sources become increasingly scarce, more innovative solutions need to be designed and implemented in urban areas to ensure its availability to future generations. This has resulted in the need for urban planners and water experts to adjust their thinking around what it means to be water secure.

As stated by Schneider, Rickert & Spieker (1973) the sphere of urban planning is complex and multifaceted as it attempts to integrate the environmental, economic, social and political factors into an implementable plan. Just as land use planning is concerned with the functions and density of spatial activities, water planning should be considered as a key aspect within the environmental sphere (Schneider, Rickert & Spieker, 1973). Spatial functions and activities should be created and recreated around water and the ecosystems and organisms they host. For this to be accomplished, there needs to be greater understanding of water systems within the urban planning sphere, and urban systems within the realm of water services and management (Schneider, Rickert & Spieker, 1973). To better deal with growing urban populations and the demand for vital water resources, the frameworks of WRM, IWRM and IUWM were developed.

2.4.1 Water Resource Management

Water has been guiding settlement patterns throughout history, often leading people to settle along river banks to enable their access to water. Due to the increase in technological solutions since the industrial revolution, water technology has allowed for settlement further from water sources (Cameron, 2014). As cities expanded, developed and increased in population there was an increasing need for water to meet the various needs of residents. Growing cities mean increasing the need for and protection from water and water hazards, such as flooding (Savenije & van der Zaag, 2008).

The development of this concept allowed governmental institutions to undertake the responsibilities concerned with the water supply (Hassan, 2011). This is typically done on three different levels, namely national, provincial/regional and municipal/metropolitan scales. As Bahri (2012) stated, former dominant WRM practices have encouraged the separation of water uses into various management sectors such as water supply, wastewater, sanitation and storm water. These sectors are intrinsically linked to the land use, economics and environmental sectors, which also lie within separated management sectors (Bahri, 2012). This lack of coordination within the management of water resources and between sectors contributed to the disregarding of ecosystem needs (Savenije & van der Zaag, 2008).

According to Radif (1999) water management has undergone rapid change over the last 300 years, beginning with the onset of industrialisation. The evolution of water management can be classified roughly into three eras: the pre-industrial era, the period from the industrial revolution to the 1960s and the post-industrial period beginning during the 1970s to the 1980s (Cameron, 2014).

Firstly, the aim of water management during the pre-industrial era was to increase the supply of water to ensure it met the demands of users (Koudstaal, Rijsberman, Savenije, 1992). It was during this time where water was typically used for domestic and agricultural purposes among other environmental and ecosystem functions (Cameron, 2014).

The purpose of water management during the second era was to maximise the supply of fresh water to users. However, from 1960 to 1970 the water paradigm was more focussed on the engineering approach of to "predict and provide" water (Savenije & van der Zaag, 2008:293). Water was a renewable resource that could be exploited for economic benefits at the expense of the natural environment (ibid). This was evident in the increase of individual water-infrastructure projects which took place (ibid). It was during this period that the construction of big dams increased in developed nations such as the United States, which gave rise to management, legal, social and financial complications (Hassan, 2011).

The third era began between the late 1970s and the early 1980s in response to the politicisation of water and natural resources (Cameron, 2014). It was from the 1980s to the 1990s that there was a rise in environmental consciousness and the fact that water could be exploited was recognised (Savenije & van der Zaag, 2008). There was also a slight shift to more holistic water planning as project-based planning was replaced with regional and national water planning (ibid). Hence, leading to the change from a supply-driven approach to a demand-driven approach to water management, allowing citizens to take responsibility for their water supply as opposed to being passive recipients of governmental services (ibid; Saxen-Rosendahl, 1995).

As stated by Snellen & Schrevel (2004) the key critique of WRM is that the sectoral management of water resources is highly inappropriate and leads to silo, unsustainable development with major negative

impacts on the ecological environment. This divide led to economic development and advancements within the built environment taking priority over ecological and environmental concerns (Savenije & van der Zaag, 2008).

2.4.2 Integrated Water Resource Management

According to Gooch, Rieu-Clarke and Stalnacke (2010) the roots of IWRM can be found in the timeline of WRM, specifically in the establishment of the Tennessee Valley Authority (TVA) in 1933. The process of establishing the TVA focused on the current IWRM ethics, which is planning that strikes a balance between the utilisation of natural resources and the sustainability of social, economic and environmental sectors (Gooch, Rieu-Clarke & Stalnacke, 2010). The Global Water Partnership (GWP, 2000:22) defines IWRM as:

"*A process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems*."

As stated by Radif (1999) the main objective of water management is to satisfy the needs of countries for them to develop sustainably. IWRM is based on the idea that water is vital to ecosystems, a natural resource, an economic good and a social necessity (Radif, 1999). The quantity and quality of water determine its utilisation and the way it is treated, however the opposite is also true. To a large extent, the way in which human behaviour is conducted, regarding water and the environment, affects the quantity and quality of available fresh water. Thereby highlighting the need for an improved socio-environmental approach to water, not merely its management. The integrated approach should also adopt policies that recognise this and base the allocation of water resources on equity and efficient use (ibid).

Key features of IWRM include the carrying capacity of the natural environment, demand management and integrated management (Snellen & Schrevel, 2004). The logical start to implementing IWRM would be to determine the carrying capacity of the natural environment (ibid), as very little can be achieved without natural resources and nothing can be achieved when water and water systems are ignored. This goes in opposition to previous approaches

where natural resources were a human right to be exploited, and its deterioration was simply a consequence of development (ibid).

Secondly, demand management was aimed at limiting the demand for water by increasing efficiency and reducing waste (ibid). This also encourages individuals to take initiative regarding water usage, as opposed to relying on governmental institutions.

Lastly, integrated management implies that water should be considered as an integral part of social and economic development (ibid). Theoretically, in analysing these main features, the practice of IWRM should either lead to or directly benefit various natural ecosystems.

The principles of IWRM were developed in response to increasing global water challenges, to guide its application and to enhance sustainable development. These were presented at the Dublin International Conference on Water and Environment in 1992. According to the GWP (2000) these principles are fluid and can be adapted to various contexts over time. However, Snellen and Schrevel (2004) do not share this view. This will be further discussed in the critique section of this review. The four Dublin Principles are (GWP, 2000:13-14):

1. *Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.*
2. *Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels.*
3. *Women play a central part in the provision, management and safeguarding of water.*
4. *Water has an economic value in all its competing uses and should be recognized as an economic good.*

The first principle emphasises the need for a holistic approach to water as it sustains life as we know it. It recognises the fact that ecosystems work together, each contributing to and relying on each other to make a system work (GWP, 2000).

The second principle highlights the need for involvement of all stakeholders, on local, metropolitan, national and international

scales. This process involves raising awareness around water issues among the public and decision makers (Snellen and Schrevel, 2004). At a local level, decisions should be taken with full public participation in the planning and implementation phases of various projects (ibid), hence abiding by good spatial planning principles.

The third principle addresses gender inequalities within water management. Women play a vital role in the collection and safeguarding of water on a local or domestic scale, but have a significantly less influential role in the management, problem investigation and decision making of water issues (GWP, 2000). Agreement and execution of this principle requires policies to equip and empower women to participate on all levels of water resource management (Snellen and Schrevel, 2004).

While the fourth and final principle emphasises the recognition of water as an economic good, it is of utmost importance to acknowledge water as a human right first. One of the strategies of the commodification of water is to prevent wastage of the resource and further environmental damage (Snellen and Schrevel, 2004). The commodification of water may be acceptable in the industrial and commercial spheres, however, on a social level it has the potential to increase conflicts and exacerbate poverty and impoverished conditions.

Even though implied in literature, these principles do not entail specifications such as water being vital to ecosystems, protection of functioning aquatic ecosystems, compromise between human and ecosystem water-needs, and the prioritisation of satisfying basic human needs and protecting ecosystem needs (Snellen & Schrevel, 2004). This oversight allows for the manipulation of IWRM principles and guidelines to cater for predetermined goals of development and management and the reduction of ecological concerns. This calls for an environmentally focussed water paradigm or the revival of it (Radif, 1999). This idea also links back to the ecological water paradigm which recognises water as part of all life supporting systems (Hassan, 2011).

2.4.3 Integrated Urban Water Management

Integrated Urban Water Management (IUWM) has developed largely from IWRM, holding the same values and similar principles but concentrating on the metropolitan scale. The United Nations Environment Programme (UNEP, 2003:2) states that IUWM can be defined as, "*the practice of managing freshwater, wastewater, and storm water as links within the resource management structure, using an urban area as the unit of management.*" In this definition, freshwater, wastewater and storm water are recognised as elements of a comprehensive physical system situated within an organisational framework, which is then situated within the natural landscape context (Mitchell, 2006). The development of this concept occurred because of rapid population growth and increased water consumption and fewer water sources, all of which are results of climate change (Bahri, 2012).

The GWP (2013) states that IUWM calls for the alignment of urban and basin-level management to achieve cross-sectoral goals between the economic, social and environmental spheres. Within the water management sector, this concept connects freshwater supply, sanitation, storm water and wastewater management, incorporating land use planning and economic development (GWP, 2013). IUWM also connects urban water planning with various sectors of the built environment such as land, housing, energy and transport to prevent fragmented governance and duplicated policies. This can be done through the amendment of land use, water or spatial planning regulations along with collaborative planning within and between government spheres and the public (Whitler & Warner, 2014). For instance, urban water planning with successful partnerships should result in urban planners playing a role in the demand and supply of water resources (ibid).

These cross-sectoral collaborations encourage collective goals, common working culture and negotiated power systems and shared resources (GWP, 2013). The Global Water Partnership (2013:2) sets out the following principles for IUWM:

- *Encompass alternative water sources; match water quality with water use;*
- *Integrate water storage, distribution, treatment, recycling, and disposal;*
- *Protect, conserve and exploit water resources at their source;*

- *Account for non-urban users;*
- *Recognise and seek to align formal and informal institutions and practices;*
- *Recognise relationships among water, land use, and energy;*
- *Pursue efficiency, equity and sustainability;*
- *Encourage participation by all stakeholders.*

The overall goal of these principles is to achieve a holistic system of urban water management while allowing for more cyclical flows of water, hence conforming to WSUD principles which will be discussed in section 2.6. Within IUWM, components such as water WSUD, sustainable urban drainage systems (SUDS), and green infrastructure, materialise. These components exist as strategies on planning and implementation levels to achieve sustainability on various levels of urban life. These varying components also encourage context specific solutions to urban water management.

2.4.4 Critiques of IWRM and IUWM

These critiques mainly focus on the planning and implementation phases of the concepts. There are two main critiques of IWRM and IUWM. Specifically, the concepts are too broad and vague, which has resulted in the second critique that there is a lack of implementation. This section critiques the IWRM and IUWM frameworks.

The global scale at which IWRM was developed leads it toward general principles and guidelines, making it difficult to adapt to local contexts (Jeffrey & Gearey, 2006). These frameworks are also difficult to apply in developing nations since the concepts of IWRM and IUWM were created in the context of developed nations. This then begs the questions:

- Who decides what sustainable development is?
- What does it look like from the perspective of developing nations and, more specifically, from an African perspective?
- What does successful IWRM and IUWM look like from an African perspective?

Snellen and Schrevel (2004) also express concern over the practical implications of the broad principles. Ideally these principles would be adapted to different global contexts to ensure integrative water resource management (GWP, 2000). However, these principles are ambiguous and their interpretation can be suited to various forms of water resource management including unsustainable management. For instance, the economic valuing of water is taking place over the valuing of water as a human right.

As can be seen in the attitudes of these management frameworks, the key underlying assumptions include political stability; regarding the natural environment as a *thing* to be managed; entrenched binaries where nature versus development; and having modernity as a goal (Funke's et al, 2007).

The global scale at which these frameworks are aimed increases the complexity of its implementation. As stated by Cameron (2014) the complexity of integrated approaches such as IWRM and IUWM highlights the lack of tools to enable holistic responses to climate change and resource insecurity. With urbanisation and climate change conditions occurring at unprecedented rates, the evolution of development and water paradigms are now more than ever grounded in spatial planning and development. Spatial planning has the potential to assist in a water-friendly development and management framework as it encourages collaborative approaches which cuts across disciplinary, professional and administrative boundaries (Nadin, 2007). Spatial planning has the potential to contribute to a sustainable development and improved water management, through levering policy changes in several sectors such as the built environment and ecological and water sectors (ibid).

2.5 Role of Spatial Planning in Water Management

Spatial planning has the potential to contribute to a world view which considers and integrates water more closely into the built environment than to the status quo. Spatial planning is typically defined as a system of approaches used to influence people and activities in spaces at different scales, with the goal of fostering positive human and environmental progress by promoting social justice and environmental sustainability. The field of spatial planning

is, therefore, inherently political and involves governmental values, legislation and institutional capacity (Davoudi, Crawford & Mehmood, 2009). Spatial planning provides a space where strategies for identified problem areas can be designed, and trade-offs between economic and social goals can be negotiated (ibid).

Over the last 20 years, as environmental and climate change issues gained attention, spatial planning for climate change has become an increasingly urgent issue and is changing the context and nature of spatial planning at all levels (Davoudi, Crawford & Mehmood, 2009). Current planners must deal with unprecedented climate issues, which have yet to be factored into decision-making processes, making spatial planning for climate change increasingly complex and uncertain (ibid).

The difficulty in integrating water management and spatial planning lies in the diverse backgrounds of the respective fields (Schneider, Rickert & Spieker, 1973). The former is based on the findings within the physical sciences while the latter is a hybrid mix of the social sciences and the built environment professions (ibid). This combined with the nature of water sources being indefinite and without jurisdiction hinders integrated urban water planning mechanisms. This highlights the need for increased positive collaboration between the two spheres (ibid). Whitler and Warner (2014) highlight three ways in which planners could contribute to IUWM. These include:

1. The regulations governing land use and water management systems require policy application, formation and innovation to enhance positive spatial impacts. This also links to the protection and conservation of water sources, as well as the planning, implementation and management of green infrastructure.
2. Collaboration with various sectors to ensure positive water-sensitive spatial outcomes. For instance, planners and developers should collaborate to ensure the usage of water sensitive urban design (WSUD) principles.
3. Water demand and population forecasting because of rapid urbanisation, natural resource insecurity and climate change.

Increasing climate concerns have led to more practical sustainable development techniques such as green infrastructure and WSUD. To ensure climate and water sensitive spatial planning, these

techniques, combined with collaborative and integrative management tools, could enhance the future of urban water planning.

2.6 Green Infrastructure & Water Sensitive Urban Design

Green infrastructure is made up of a variety of tools and practices and can be defined as an approach to water management that protects, restores or mirrors the natural water cycle (American Rivers, 2017). It does this in a way that requires an increase in vegetation and wetland restoration as well as co-operation with various water management strategies (ibid). Green infrastructure can also be a series of green and blue spaces, which conserves and protects ecosystem values and functions while providing benefits to society (Lafortezza, 2013).

As stated by Seung-Hyun (2015:2) Benedict and McMahon's widely accepted definition of green infrastructure is "*an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations*". This concept is shaped by three interrelated ideas and encompasses natural and restored ecosystems, which forms a system of hubs, sites and links (Seung-Hyun, 2015). These three ideas include: connectivity, multi-functionality and the natural environment (Schiappacasse and Müller, 2015). This is naturally interlinked with the system of hubs, sites and links. Within the sphere of green infrastructure, hubs include open spaces such as community parks, reserves and publicly owned land (ibid). Sites are smaller than hubs and include local areas intended for nature-based functions (ibid). The links are what connects this system of ecological spaces and are vital to the functioning thereof; these include greenbelts or floodplains (ibid).

This tool can be used in the field of spatial planning and encourages the shift from current, economically focussed development practices to environmentally centred development practices, which once more returns to the previously discussed ecologically-sensitive water paradigm. It also abides by the widely accepted definition of sustainable development as it is a practice which aims to protect the natural environment, to ensure its natural resources reach future generations.

The aim of green infrastructure policies in developed countries, specifically in the United Kingdom, is to guide metro-scale development and to ensure the consideration of climate change impacts (Lafortezza, 2013). Green infrastructure is a central tool to ecosystem restoration while abiding by climate-sensitive and sustainable development principles. There is a key link between ecological and social factors as the former enhances the latter. Current development patterns have resulted in fragmented patterns of open-space systems that hinder ecosystem functionality (ibid).

The socio-ecological approach to city development is a key theme in green infrastructure literature; it envisages cities as containing human-nature systems where institutional adaptability is a key aspect in urban resilience (Schaffler & Swilling, 2013).

Urban resilience, defined as the ability and capacity of socioecological systems to absorb shocks and retain essential processes and structures (Adger et al, 2005), is a key element of green infrastructure.

Since green infrastructure has become a tool for sustainable development (Schiappacasse and Müller, 2015), it should be a key aspect of spatial planning. From a spatial planning perspective, achieving a resilient city can be done through the implementation of green infrastructure, as it encourages: diversity, connectivity, systems thinking, knowledge-building, collaboration and multi-level governance (Schiappacasse and Müller, 2015).

Since the publishing of the Brundtland Report and the development of the concept of sustainable development, sustainable drainage systems have been considered as an alternative to traditional drainage systems (Zhou, 2014). This concept aims to change the impact of the built environment on the natural water cycle by establishing an all-inclusive management system for the latter, as opposed to the current fragmented system of water management. WSUD can be described as "*the interdisciplinary cooperation of water management, urban design, and landscape planning*" (Hoyer et al, 2011).

This concept considers all parts of the urban water cycle and combines spatial planning, urban design and water management functions (ibid). It is also a strategy in the fields of planning and

engineering to integrate water management into the urban landscape while minimizing environmental degradation and achieving a harmonized relationship between water and the urban environment (Zhou, 2014).

As stated by Zhou (2014), traditional drainage systems have one main objective, which is to maintain or achieve good water quality, which has typically been achieved through grey infrastructural solutions. These systems have been designed to collect and transport water away from urban areas as quickly as possible, resulting in the *out of sight, out of mind* treatment of water (Zhou, 2014).

WSUD on the other hand encourages the incorporation of rain and ground water harvesting with other elements of urban water, such as runoff quality, recreational value and ecological protection (ibid). It should be a key aspect of green infrastructure planning as it promotes the sustainable usage and integrated maintenance of key water supplies, thereby ensuring maximum benefit per drop. In the field of WSUD, it is encouraged to treat water as a positive source to create new recreational and aesthetically pleasing sites in the urban environment (Zhou, 2014).

Rapid urbanization and climate change have led to challenges experienced within the urban and natural environments. The effects of climate change have resulted in varying impacts in different geographical locations. For instance, in areas predicted to receive increased rainfall and possible flood risk, WSUD and traditional drainage systems will have to increase their capacities to prevent the system from overloading (Zhou, 2014). In areas predicted to become hotter and drier because of climate change, green infrastructure and WSUD techniques will have to be used strategically to capture and store water to prevent complete droughts. Both green infrastructure and WSUD positively reinforce each other as the sustainability of ecological and social ecosystems are prioritised, ensuring a positive environment for future generations.

2.7 Conclusion

Currently, urban areas across the globe are growing rapidly, especially within Africa and Asia, and are in the process of increasing consumption and production while contributing to global climate change. Urban spatial planning is a field which encourages the long-term construction of cities, metropoles and the values they hold. It therefore has the potential to take the lead on key water and sustainability issues across the globe, as this type of development must have the future in mind to ensure the survival of humankind. Urban planning can address this key issue through the enhancement of planning and implementation of green infrastructure and WSUD techniques. These techniques are required for a balance between economic growth and development, and for the alleviation of and adaptation to the effects of climate. Over time, traditional development practices would have to be replaced to ensure long term adaptation to climate change.

Chapter 3

3 Contextual Analysis: Exploring Oranjezicht and Deer Park

3.1 Introduction

The literature reviewed in the previous chapter provides a theoretical framework for this chapter as well as the chapters to follow. It highlights the ways in which spatial planning and urban water management can collaborate to ensure positive social and ecological changes within cities.

The purpose of this chapter is to analyse the status quo of the site in its capacity as a future water sensitive site to contribute to the improvement of Cape Town's water-culture. It analyses the role and function of Oranjezicht, Deer Park and the Platteklip Stream in its current context. It attempts to understand the current conditions within the area and the opportunities and constraints it may contain. The following section looks at the historical significance of the Platteklip Stream as it contains cultural significance for a variety of people.

3.2 Historical Analysis: The Camissa River System

The history of Cape Town is intimately linked to its water sources, the city was particularly known for its abundance of fresh water flowing from the slopes of Table Mountain (Figure 3.1). *Camissa* meaning The Place Sweet of Waters was the name given to the Cape by the Khoikhoi people, i.e. the first pastoralists in southern Africa, due to the abundance of freshwater ("Reclaim Camissa", 2013). Consequently, the name Camissa was also given to one of the many fresh water systems flowing from Table Mountain, which gave rise to the development of the city (von Zeil, 2011). Originally, there were four main watercourses flowing from the face of Table Mountain, namely the Platteklip Stream, Molenwater, Third Stream and Zwaartwater (Brown & Magobo, 2009). Today, the Platteklip Stream is one of the system's main rivers still flowing, with the headwater stream flowing in the Upper Oranjezicht and Deer Park areas (see Figure 3.2). The highly valuable water resources, along with other natural resources, were among the reasons the Dutch colonists settled in Cape Town (Burman, 1962).

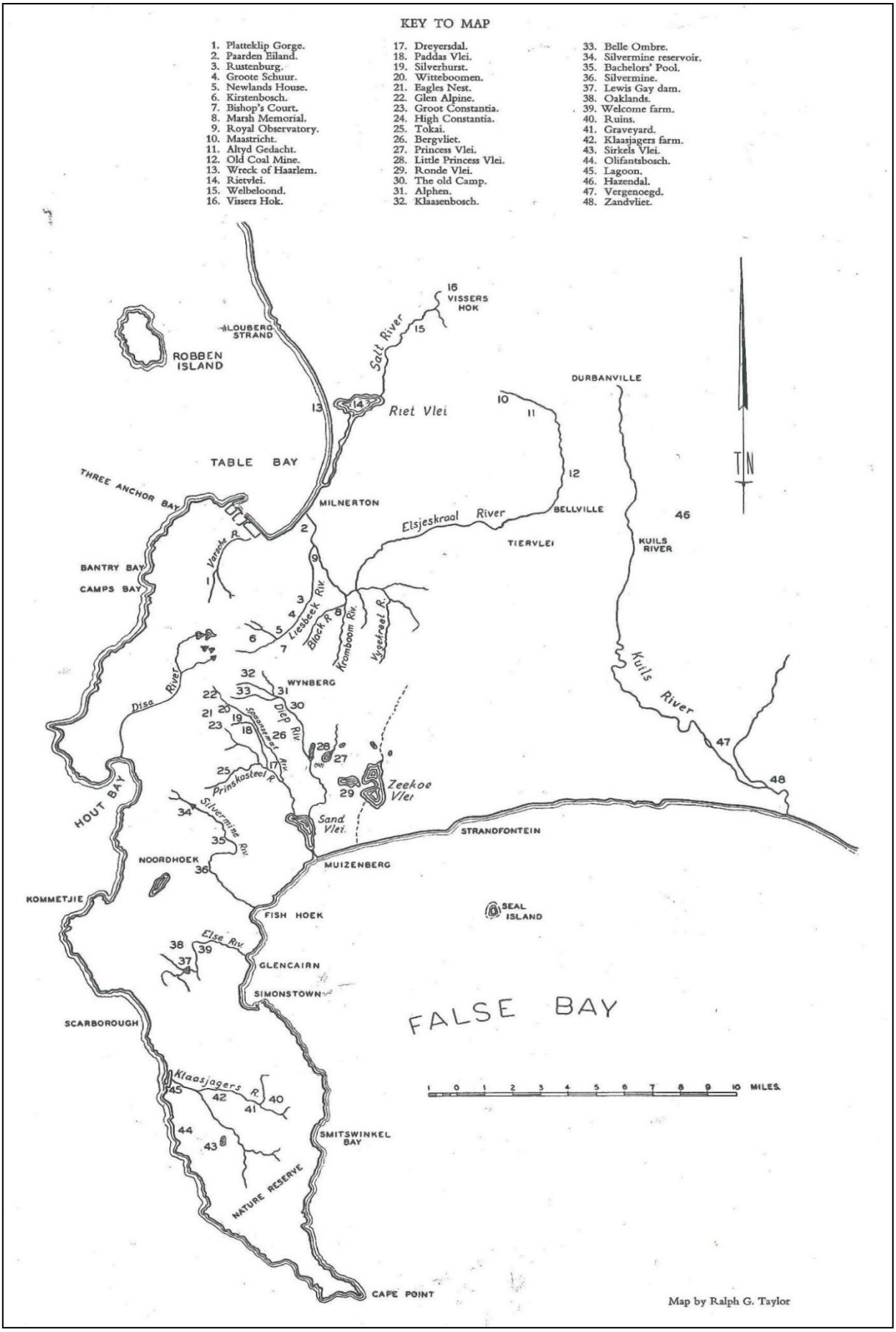

Figure 3.1: Cape Town's historical water sources originating from the Table Mountain Range (Burman, 1962)

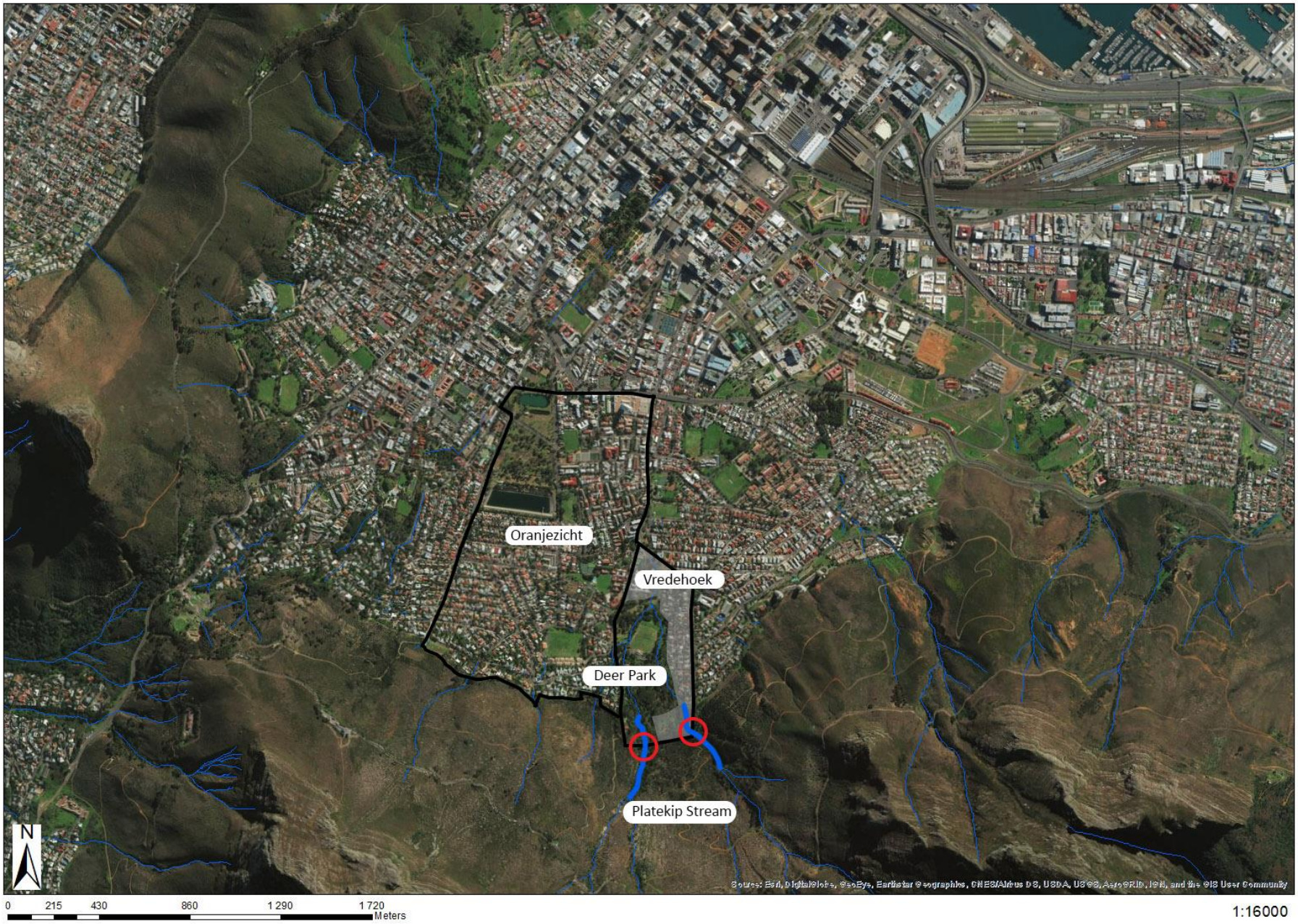

Figure 3.2: The entrance of the Platteklip Stream into the Study Area (UCT GIS Data, 2015)

Figure 3.3: Showing the location of Swartland Region in relation to the city of Cape Town (Adapted from Htonl, 2010).

Pre-colonial residents of the Cape as well as early colonists established themselves around water sources such as vlei's and rivers (Brown & Magoba, 2009). The San, Khoikhoi and Strandlopers, who were the main custodians of the land and its resources, travelled to the Cape from the Swartland region (ibid). This area is located along the northern border of the Cape Town Metropolitan region (see Figure 3.3). This seasonal migration was done annually, between November and January, to graze their animals, hunt and harvest edible plants and water (ibid). During the pre-colonial era, indigenous resources were used on a seasonal basis, with little to no ownership of land, water or other resources. For example, the San people were hunter-gatherers who were characterised by their nomadic behaviour (ibid). They lived and travelled in small family units as they "followed the rains" with their cattle and sheep while they settled briefly in different areas (Guelke & Shell, 1992:3). This was done to utilise seasonal resources, such as water and game, from different parts of the Western Cape (Guelke & Shell, 1992).

As stated by Brown and Magoba, (2009) the Khoikhoi people settled along the eastern, western and southern coastal borders of the Cape. They practised sheep and cattle farming which involved periodic separation and reunification of people and their livestock as they performed seasonal migration to different grounds (Guelke & Shell, 1992). The Khoikhoi people used land and its resources in very

efficient ways, as they would allow their livestock to graze in an area for a short time before moving on (ibid). This method gave the land and water sufficient time to rejuvenate itself (ibid).

The Dutch arrived in the Cape in 1652 with the intention of setting up a refreshment station since the location of the Cape made travelling between the west and east easier. As stated by Kotzé (2010) Jan van Riebeek's first engineering project in the Cape was a water supply system, which was a jetty and a walkway, to supply sailors passing through the Cape with fresh water. This fresh water flowing from the slopes of Table Mountain also made it the ideal location for a refreshment station with fresh water, fruit and vegetables. It was under Jan van Riebeek's command that the main Camissa River, flowing down the face of Table Mountain, was renamed to *Varshe Rivier* (Brown & Magoba, 2009; Burman, 1962). The water used to supply the newly established garden came from the Oranjezicht springs, which originated on Table Mountain, at the top of Platteklip Gorge as can be seen in Figure 3.4 (Kotzé, 2010). Water from the springs formed part of a gravity fed system with opening sluice gates (ibid). The water was transported by means of a ditch along what is now Orange Street, to the gardens, which consisted of freshwater canals alongside it to prevent animals from damaging the crops (ibid). Figure 3.4 shows the current location of Orange Street in relation to the study area.

The River was then organised into a network of furrows, along with other smaller rivers and streams (Brown & Magoba, 2009). The *Varsche Rivier*/ main *Camissa* River/ *Platteklip Stream* became the single most important feature of the Cape as it gave life to the City of Cape Town as it is known today (Burman, 1962).

The water flowing from Table Mountain was a source of life for the indigenous people of the Cape since the Stone Age as the Khoi-San people used it periodically and sustainably (Brown & Magoba, 2009).

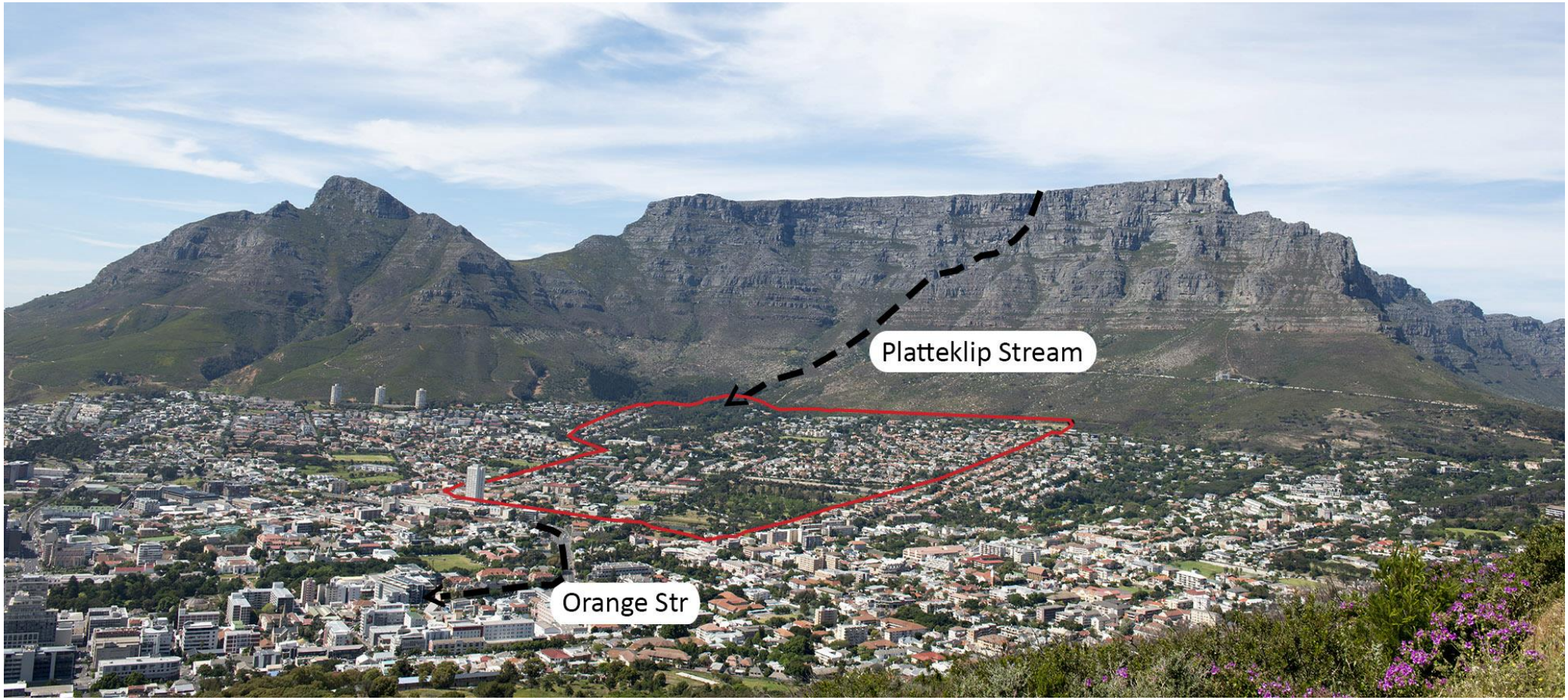

Figure 3.4: Showing the Historical water-flow from Platteklip Gorge, Orange Street and the study area indicated in red (image adapted from Hoffmann, n.d. for Vienmma Tours)

As stated by Burman (1962), this water then became a source of life for the European colonists of the Cape considering that it was used for:

- domestic purposes;
- the provision of fresh water;
- to drive the mills of the Dutch East India Company (DEIC);
- to serve as a reservoir for ships;
- to supply the moat surrounding the castle;
- to irrigate newly established garden.

As stated by Kotzé (2010) it was up to the year 1891, that the Table Mountain springs were the main source of water. Eventually, in the year 1895, the Table Mountain Rivers were used for electricity production (Von Zeil, 2011). After the arrival of the Europeans in the Cape, the Khoikhoi people were excluded from the land and resources to the west of the Liesbeek River (see Figure 3.6) (Brown & Magoba, 2009). The settlement grew quickly as there was a growing demand for fresh fruit and vegetables (ibid). DEIC employees claimed the fertile land between the newly established town and the mountain slopes, while the slopes of Devil's Peak and Signal Hill were used for livestock grazing and dairy farming, as indicated in Figure 3.6 (ibid). This was done because of the lack of a constant water source on Devil's Peak and Signal Hill; where local farmers could live (ibid).

The Varsche Rivier was then deepened to form a canal. A series of engineering work was done on the town's waterways, for instance the Heerengracht and Kaisersgracht waterways were altered with the purpose of supplying additional water to the castle by means of connecting with the Varsche Rivier (Brown & Magoba, 2009). It is important to note that throughout the history of Cape Town's development, the city has experienced water scarcity. The year 1661 marks a key water scarce period under colonial rule, this resulted in the construction of Waegenaer's Dam (Kotzé, 2010). More than 200 years later, during the construction of the Molteno Reservoir in the 1870s, the Cape also experienced low rainfall (Kotzé, 2011). This continued on-and-off because of the increasing population growth and, during water scarce periods, the lack of rainfall (ibid).

Cape Town relied solely on Table Mountain's water sources up until 1897 (CoCT, 2017). As stated by Dippenaar (2016), Table Mountain is

home to numerous groundwater springs and five of the oldest dams in the country. These dams include the Woodhead, Hely-Hutchinson, Victoria, Alexandra and De Villiers Dams, see Figure 3.5 (CoCT, 2017).

As the city grew and developed, the town developed its grid pattern, which was also a result of the existing waterways at the time (Brown & Magoba, 2009). Streets had channels on either side of it, which were means of both water supply and drainage (ibid). Hence, resulting in the increased pollution of the waterways. This led to the canals within the city being closed, resulting in underground tunnels transporting wastewater to the Atlantic Ocean ("Reclaim Camissa", 2013). The usage of the water sources originating in the city continually decreased and a new normal began with the construction of the city's major dams on the outskirts of the city; namely the Wemmershoek, Berg River, Theewaterskloof and Steenbras (upper and lower) Dams (this map can also be seen in Chapter 1, Figure 1.2). This improvement of water infrastructure was a result of population growth and technological advances. The importing of water from beyond the city's boundaries has remained, and is the way in which water demand and supply is managed for the city of Cape Town.

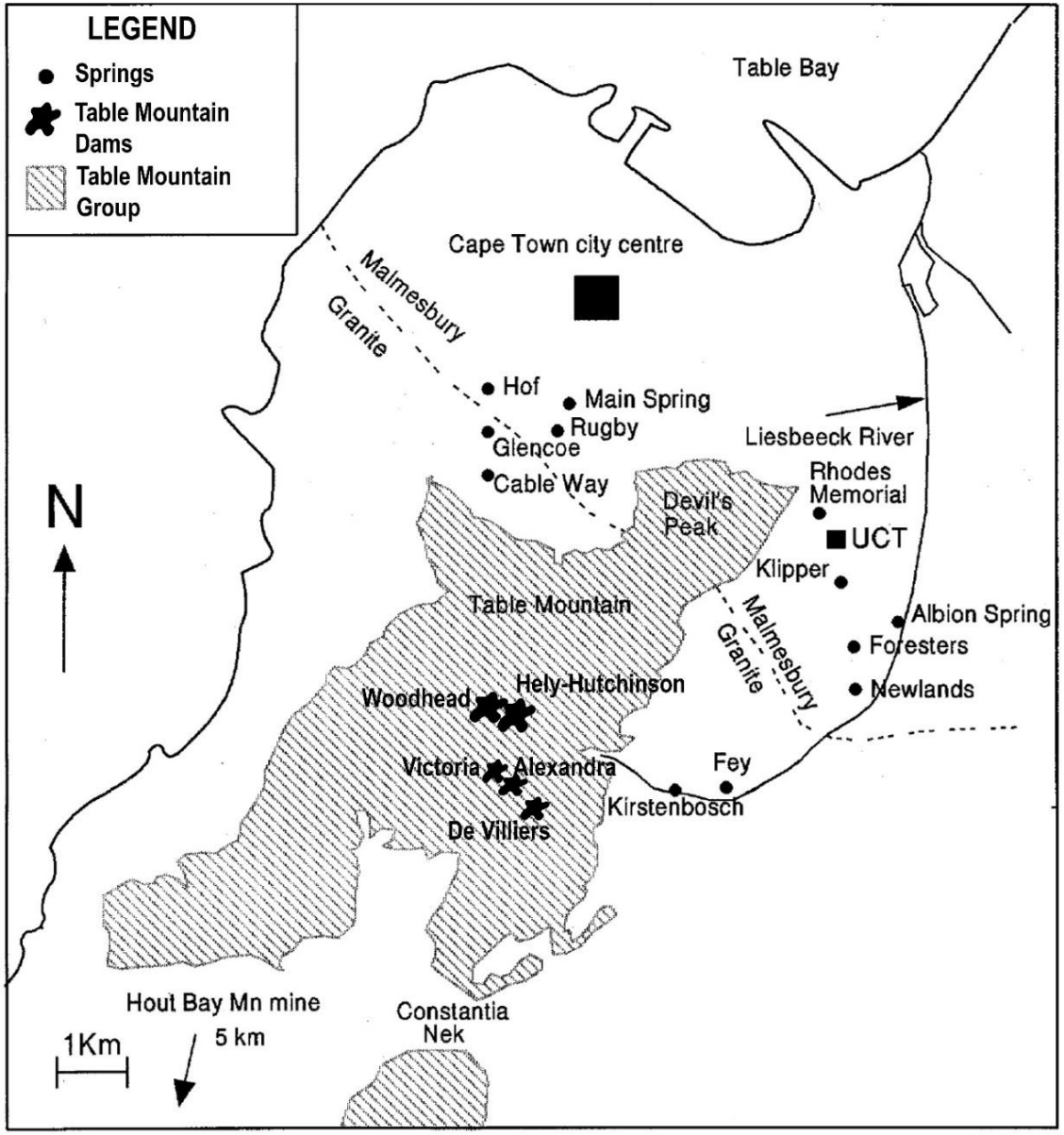

Figure 3.5: Showing the location of the dams on, and springs surrounding Table Mountain (Adapted from Harris, Oom & Diamond, 1999).

Figure 3.6: Showing the area to the west of the Liesbeek River and indicating the land used for livestock grazing and dairy farming (UCT GIS, 2015).

3.3 Spatial Analysis

3.3.1 Locating Oranjezicht and the Camissa River System

The focus area of this project is Oranjezicht, a suburb located at the foot of Table Mountain in Cape Town's CBD. This area was selected due to its historically significant water sites such as the Field of Springs, Platteklip Stream, Molteno Dam and the lesser used service dams. The two initial sites have great historical and spiritual significance, as it played a key role in the birth of the metro, therefore should be treated with utmost care. The spatial extent of the study area consists of Oranjezicht, a portion of Deer Park and a portion of Vredehoek, which includes segments of Homeleigh Ave, Chapel Rd and George Rd (see Figure 3.7). The site has a few large public and semi-public open spaces in the northwest and south-eastern corners. It also hosts the Molteno dam towards the north-western part of the site, which is undergoing construction to create a small-scale water treatment plant.

The river systems and wetlands makes up a key part of the city by playing important social and ecological roles. The main functions of the city's wetlands and freshwater systems are twofold, it creates vital habitat conditions for fauna and flora and provides a form of natural infrastructure that manages, treats and transports stormwater and treated wastewater (CoCT, 2012). The pollution of stormwater and freshwater systems presents a great challenge to the management of river systems and is the result of poorly treated wastewater effluent, overflows from impaired sewer systems and contaminated stormwater (ibid). The contamination of freshwater systems has also been a result of urban settlements alongside rivers and wetlands, which has resulted in various forms of pollution including the dumping of human waste (ibid).

To prevent the weakening of the city's freshwater systems there is a need to enhance the human-water relationship. This is especially vital due to the impacts of climate change. As stated by DEA&DP (2013), the Western Cape is predicted to become hotter and drier because of climate change and the primary climate change impacts will be felt on the water resources of the province. To survive the predicted change in climate, there is a need for a variety of multi-stakeholder and smaller scale solutions.

Figure 3.7: Showing the site, and the respective suburbs each site portion falls within; with the section of Vredehoek shaded in grey (UCT GIS, 2015)

3.3.2 Profile of Study Area: Socio-Economic Analysis

Oranjezicht, literally meaning orange view, formed part of a farmstead which was owned and operated by the van Breda family from the Netherlands in 1719 (Dippenaar, 2016). By 1856, the municipality at the time had acquired portions of the estate, springs and mills along the Platteklip Stream (Kotzè, 2011). This was done to augment the Cape's water supply (ibid).

Oranjezicht is now a middle to high-income suburb of Cape Town, approximately 1.13km^2 and is characterised by residential developments. According to CoCT GIS data (2015), most of the area is zoned as general residential with mixed use and local business zonings towards the lower reaches of the suburb as can be seen in Figure 3.8.

There are also public open spaces and utility zonings within the area. The demographic profile of the area includes approximately 75% white residents, 13% black, 5% coloured and 2% Indian or Asian residents (Census, 2011). The total population is approximately 3580, with 66% English speaking residents, 23% Afrikaans and 8% of the population speaks a non-South African language (ibid). The unequal demographics of the area, as is the case with most suburbs in the Cape, is largely a result of apartheid planning.

3.3.3 Profile of the Study Area: Biophysical Analysis

This section explores a component of the Camissa River System, defined by Brown and Magobo (2009), as the upper portion of the Platteklip Stream. This section of the Platteklip Stream flows from the top of Platteklip Gorge into the Oranjezicht and Deer Park areas. A site visit was done, starting in Deer Park at the Platteklip Stream, following the flow of water to where the stormwater infrastructure begins. This section studies the biophysical aspects of the site and includes aspects of the broader CBD area to provide an understanding of the natural environment and its potential for the enhancement of the Camissa River System (CRS).

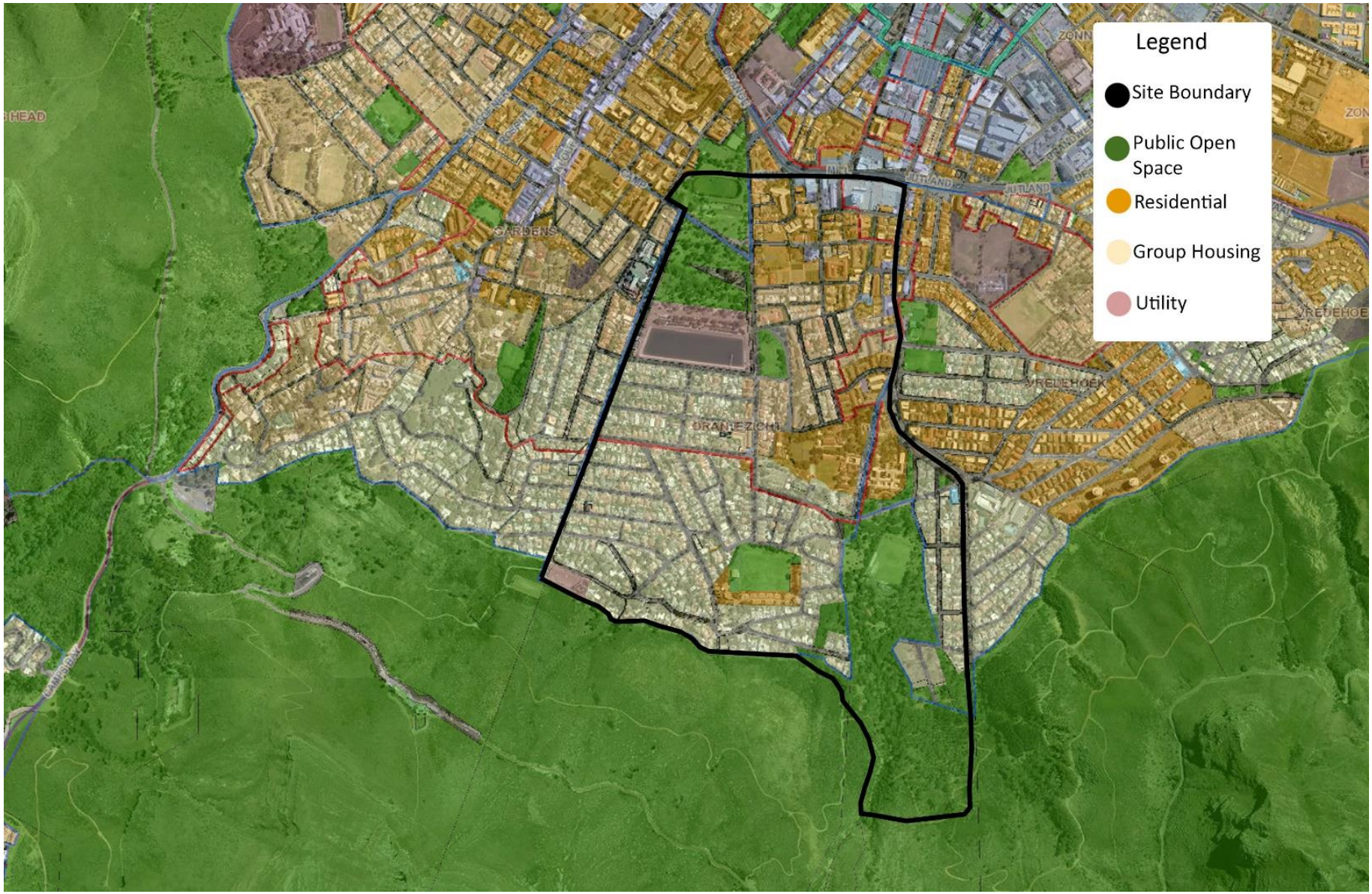

Figure 3.8: Showing the zoning within the site (Adapted from CoCT E-map, 2015)

3.3.3.1 Geology and Geomorphology

The study area has a combined total of approximately 1.45 km² and is located at the foot of Table Mountain. As can be seen in Figure 3.9, the geology of Table Mountain consists of Pakhuis formation diamictite, Peninsula formation sandstone, Graafwater formation sandstone, Cape Peninsula granite, Sea Point migmatite and the Malmesbury group meta-sediments (Dippenaar, 2016).

As can be seen in Figures 3.9 And 3.10, Malmesbury shale (forming part of the Malmesbury group sediments) underlies the granite formation at the foot of Table Mountain (ibid). This also results in poor soil quality within Oranjezicht and surrounding areas, which is evident in the growth of Fynbos on the slopes of Table Mountain.

As stated by Dippenaar (2016), on the slopes of Table Mountain, springs typically occur between sandstone and granite because of the low permeability of the latter rock type. The combination of the more permeable sandstone above the granite formations causes water to surface by flowing out laterally as opposed to percolate downwards (ibid). Hence, giving rise to numerous historical and current streams and rivers within the area.

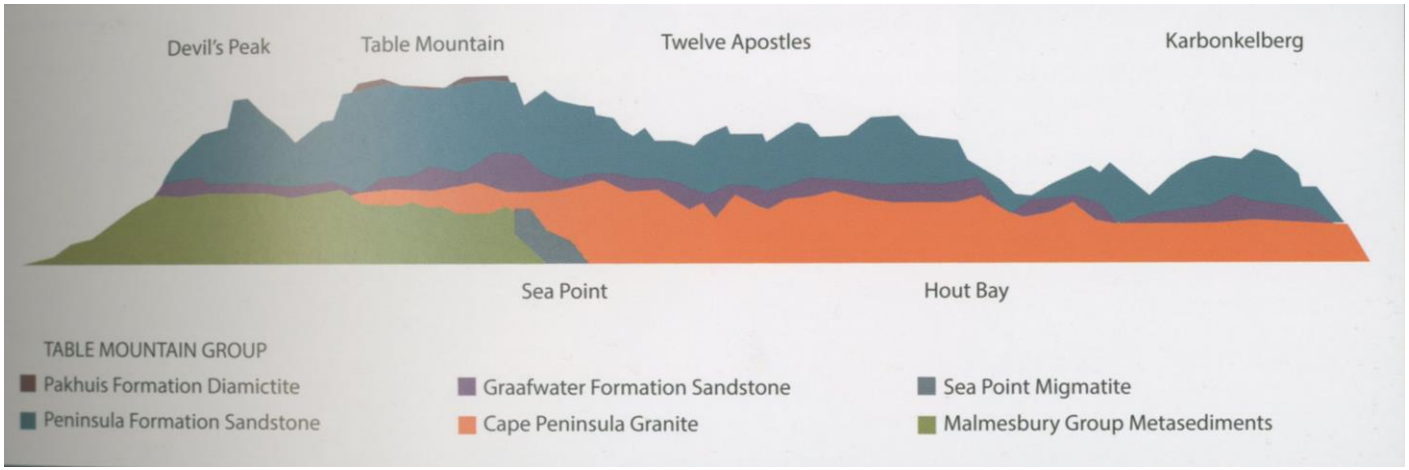

Figure 3.9: The stratigraphic units of Table Mountain and Cape Town. The springs typically occurring between sandstone and granite (Dippenaar 19:2016).

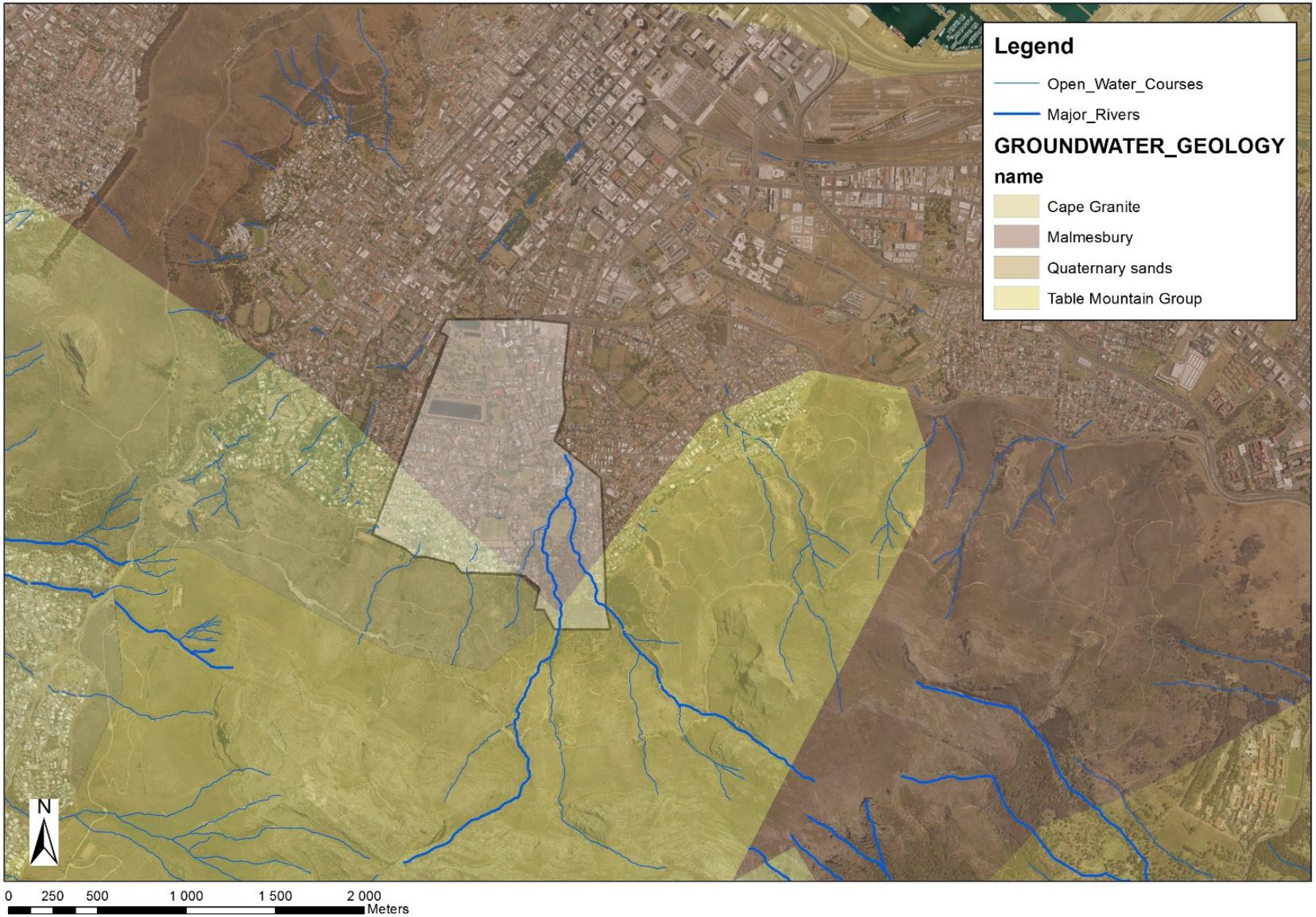

Figure 3.10: The groundwater geology of the site and its surrounds

3.3.3.2 Biodiversity

The site is located on Table Mountain, one of the Seven Wonders of the World, therefore holding great biodiversity value. Cape Town is firmly situated within the Cape Floristic Region, resulting in a wide variety of fauna and flora throughout the metropole. As stated by Wu (2009), the vegetation on Table Mountain is largely determined by the nature of the soil. The lower reaches of the mountain are covered with sandstone debris and results in a mixed soil (Wu, 2009).

Table Mountain is home to a variety of indigenous fynbos types. Mountain fynbos is highly common in the surroundings of the site. This includes Peninsula Sandstone Fynbos and Peninsula Granite Fynbos (CoCT, 2012). The vegetation on site occurs within Deer Park, it is granite and shale fynbos (Figure 3.11). This vegetation and associated ecosystems are classified as critically endangered and therefore subjected to conservation as it falls within the Table Mountain National Park (TMNP) (ibid), which can be seen in Figure 3.12.

The strong presence of indigenous vegetation on the slopes of Table Mountain also poses a fire risk due to the seasonal germination of fynbos. In recent months, the vegetation in the Deer Park area experienced a major fire, which bordered onto Vredehoek and Oranjezicht. The fires along Devil's Peak and Table Mountain typically occur during summer months, at the time of fynbos germination. In some instances, the fires are exacerbated by strong south-easterly winds. This was the case in the most recent Deer Park fire during January 2017 (Petersen, 2017).

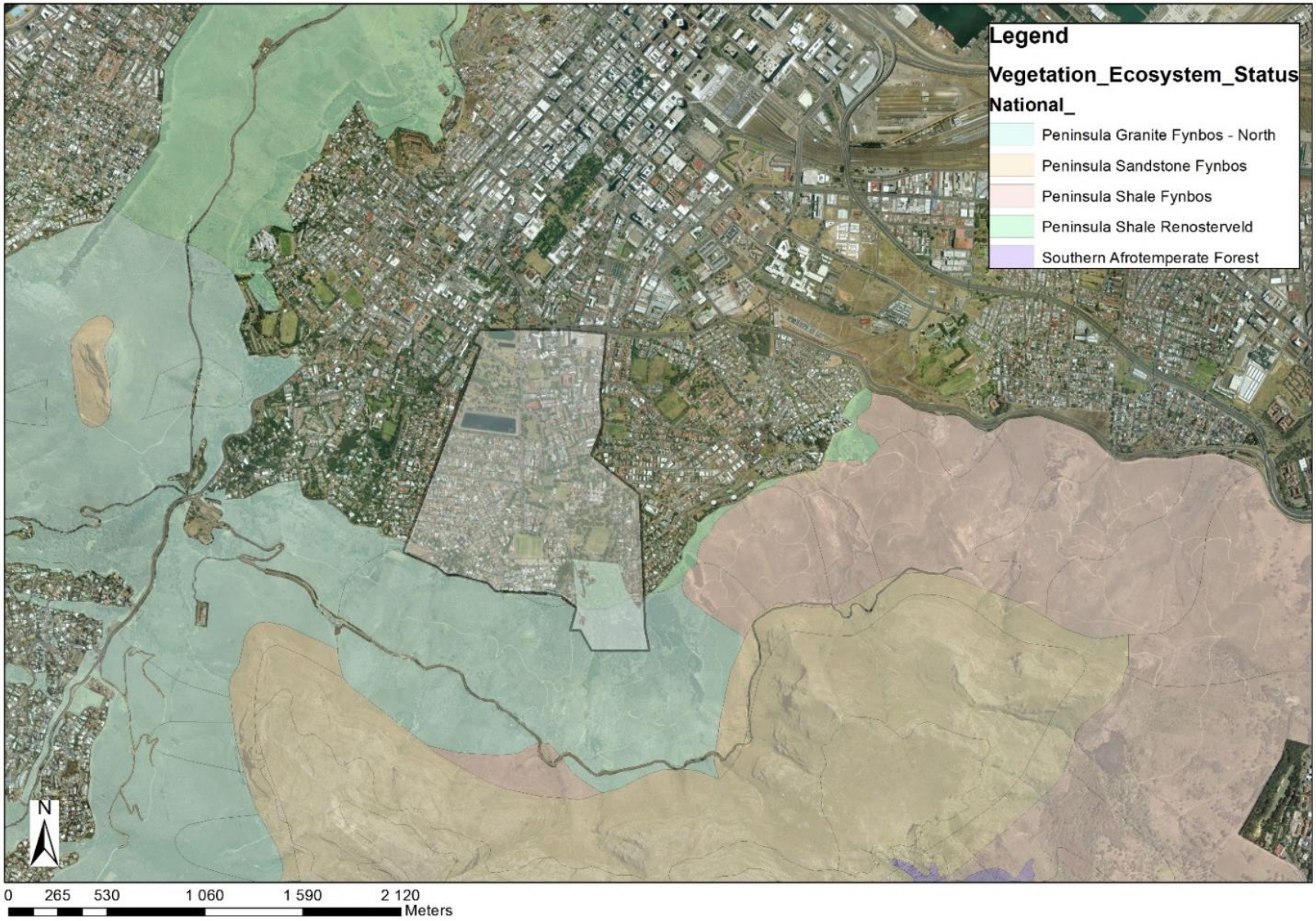

Figure 3.11: Showing the vegetation within the site and its surrounds (SANBI GIS data, 2011).

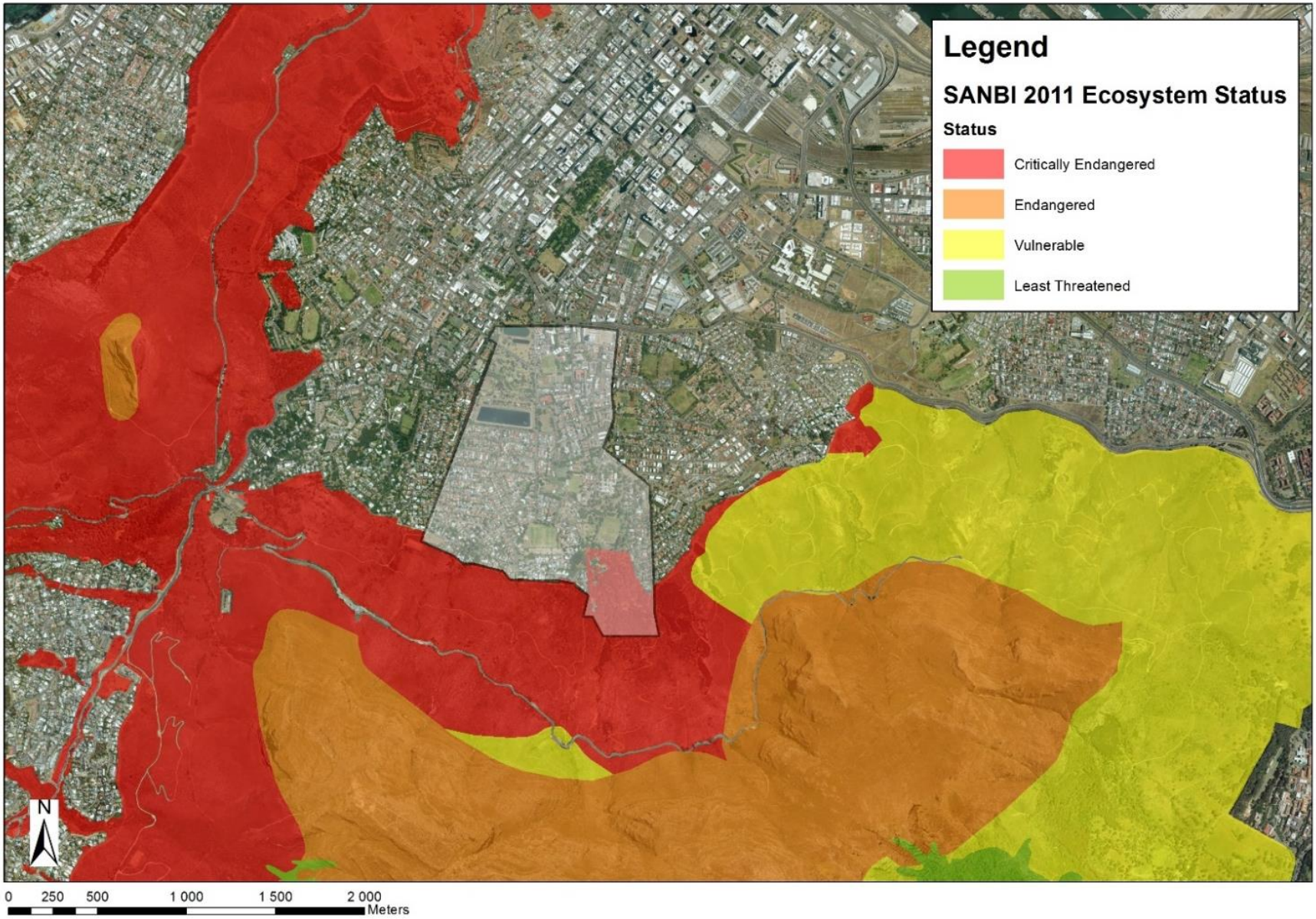

Figure 3.12: The status of ecosystems surrounding the site (SANBI GIS data, 2011).

3.3.3.3 Hydrology

As previously stated, the Platteklip Stream originates at the top of Table Mountain and flows through Deer Park (Figure 3.13). The exact amount of water forming part of the Platteklip Stream is currently unknown due to a gap in the recorded measurements of stream flow (CoCT, 2015). The stream is however said to have very low flow rates during the dry season (ibid).

However, the Stadsfontein Spring, which collects water from various CRS sources, was said to produce 3.5 million litres of water per day ("Reclaim Camissa", 2013). According to Kotzè (2011) however, this spring is also said to produce approximately 2.4 million litres of water per day (at 28 litres per second), and approximately 3.4 million litres per day (at 40l/s) when combined with other springs in the area. The spring's lowest recorded yield is currently approximately 1.4 million litres per day at 17l/s (CoCT, 2015). While this amount of water may be small in comparison to the major dams and other water sources supplying the city, this amount of water is sufficient for the Table Bay District, which has an approximate population of 170 700 (CoCT, 2012).

3.3.3.4 Climatic Conditions

Cape Town is described as having a Mediterranean climate, which is characterised by hot, dry summers and cold, wet winters, this a result of the storms caused by cold fronts (CoCT, 2017). In Cape Town, June and July are usually the wettest months of the year, receiving up to 100mm of rain per month, while December and January are the driest, receiving less than 20mm of rain per month (ibid). On average, the city receives 500mm of rain per year; there is however an uneven distribution of rainfall due to the mountainous landscape (ibid). Mountainous areas receive more rainfall than flatter landscapes, which often exceeds 2000mm per year (ibid). Lower rainfall areas such as the West Coast receive an average annual rainfall of only 300mm (ibid).

During the summer months in the Mother City, the presence of the south-easterly wind transports clouds towards the north-west resulting in summer rainfall in areas towards the north-west of Cape Town. The south-easterly wind is also part of the reason Cape Town receives little to no rainfall during summer. However, the formation of clouds over Table Mountain throughout the year causes damp

conditions which results in light precipitation on the mountain, this helps to keep the springs and streams flowing (CoCT, 2017). Hence, contributing to the flow of the Platteklip Stream.

As stated by Tadross and Johnson (2012) summer months in Cape Town lasts from November to March, with temperatures peaking in February at a monthly average of 26.9^{o}C. The city's winter months last from June to August with the lowest temperatures usually in occurring in July at a monthly maximum average of 17.7^{o}C and minimum of 9.1^{o}C (Tadross & Johnson, 2012). The climate change predictions for Cape Town include hotter and drier conditions (DEA&DP, 2013).

This is likely to have negative impacts on water because of decreased rainfall and increases evaporation rates (ibid). Increased evaporation rates will peak during summer, which could contribute to the water received during the winter months not lasting for the full season. The predictions of climate change impacts are however, becoming less predictable as weather patterns are changing in an unprecedented manner. Hence, making all water sources, from fresh to salt to recycled water, vital to urban life.

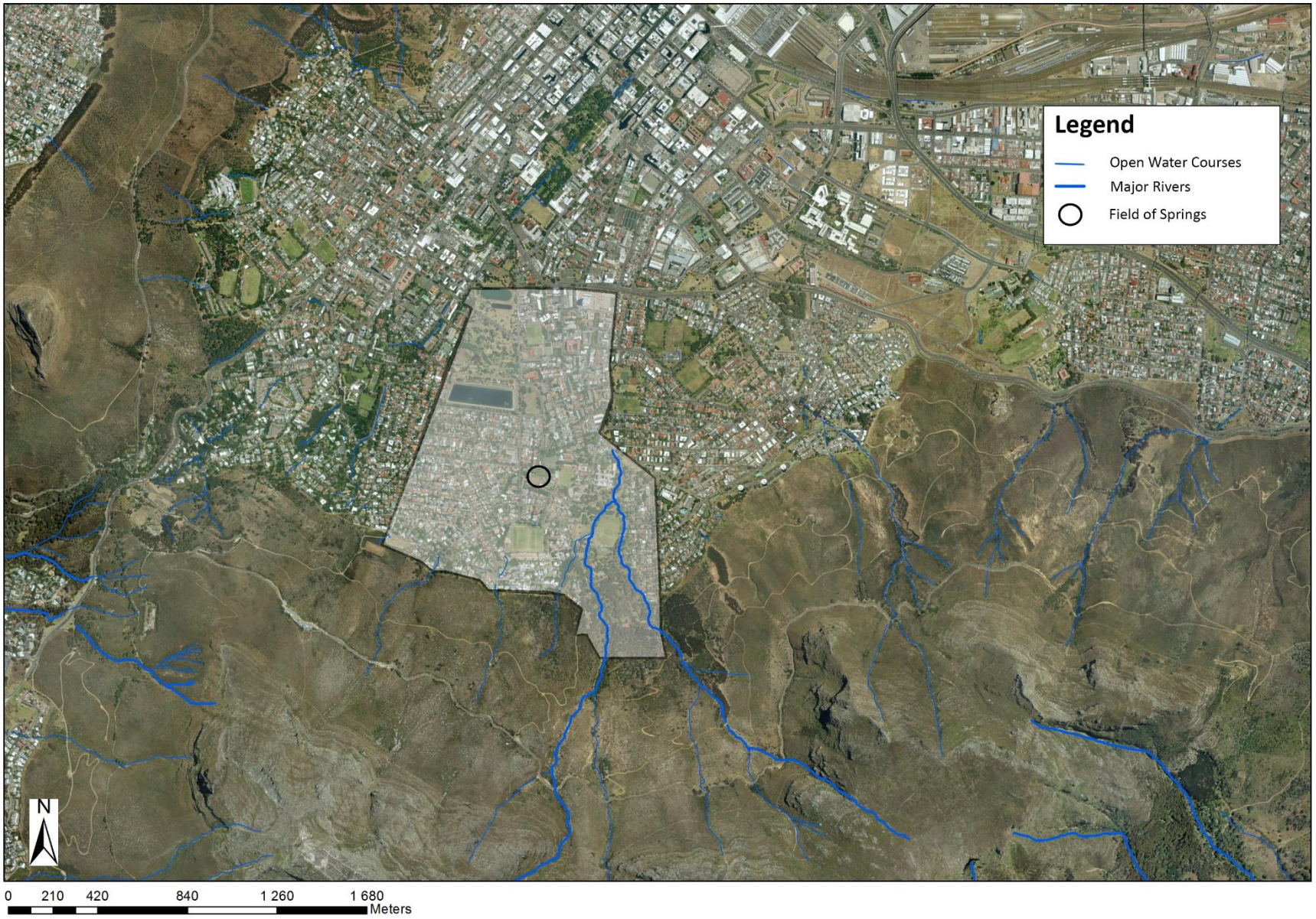

Figure 3.13: Showing the open water courses & major rivers present in Oranjezicht and surrounding areas and Oranjezicht's Main Spring (UCT GIS data, 2015).

3.3.4 Profile of Study Area: Infrastructure Analysis

South Africa faces increasing infrastructural challenges because of the apartheid legacy and sprawled city layouts. Water and related infrastructure in South Africa therefore suffers greatly due to the prioritisation of many other urgent urban challenges over the natural environment. The country in general has an abundance of natural resources which could be used as an advantage in many sectors of development, presenting great opportunities for green infrastructure becoming the new norm.

Cape Town is no exception to the infrastructural realities of the rest of the country. While the geology, soils, endemic fauna and flora and natural water systems such as rivers and wetlands provides Cape Town with natural water infrastructure (De Almeida, 2015), the man-made reticulation systems currently operate as the main water infrastructure system. The stormwater reticulation system within Cape Town's CBD plays a significant role in the current state of the CRS as these watercourses were diverted into the stormwater reticulation system at a time when these rivers were highly polluted, see Figure 3.14 ("Reclaim Camissa", 2013).

As stated by Armitage, et al (2013), the stormwater management systems in Cape Town have focussed on the collection of runoff to transport it to the nearest watercourse or directly into the ocean. Historically, this has been done to prevent flooding and to allow urban environments to operate efficiently despite weather conditions. Current stormwater reticulation systems have resulted in the prioritisation of the quantity of stormwater flow over the natural environment (Armitage, et al, 2013). This lack of consideration has resulted in negative environmental impacts such as erosion, siltation and pollution (ibid).

According to CoCT's State of Cape Town Report (2012) the main sources of pollution of Cape Town's freshwater systems are inadequately treated wastewater effluent, overflows from blocked or leaking sewer systems and contaminated stormwater. Stormwater becomes contaminated through a variety of means, such as impurities on paved surfaces; fertilizer in gardens and fields and silt from eroding areas (CoCT, 2012). According to Fisher-Jeffes and Armitage (2012), stormwater also contributes to the malfunctioning

of sewerage treatment works that become overloaded due to stormwater entering the sewerage reticulation system.

Efficient water systems require efficient catchment-wide strategies which require input from the entire urban water system (Fisher-Jeffes & Armitage, 2012). Currently, the management of the urban water cycle is fragmented and has led to a non-holistic approach to water services (ibid). Stormwater is also typically managed as a potential flood risk thereby managing the flow quantity and ignoring the flow quality (ibid). This type of stormwater management within the site and the metropole is likely to become increasingly problematic as it complicates blue-infrastructural solutions to the city's dry conditions.

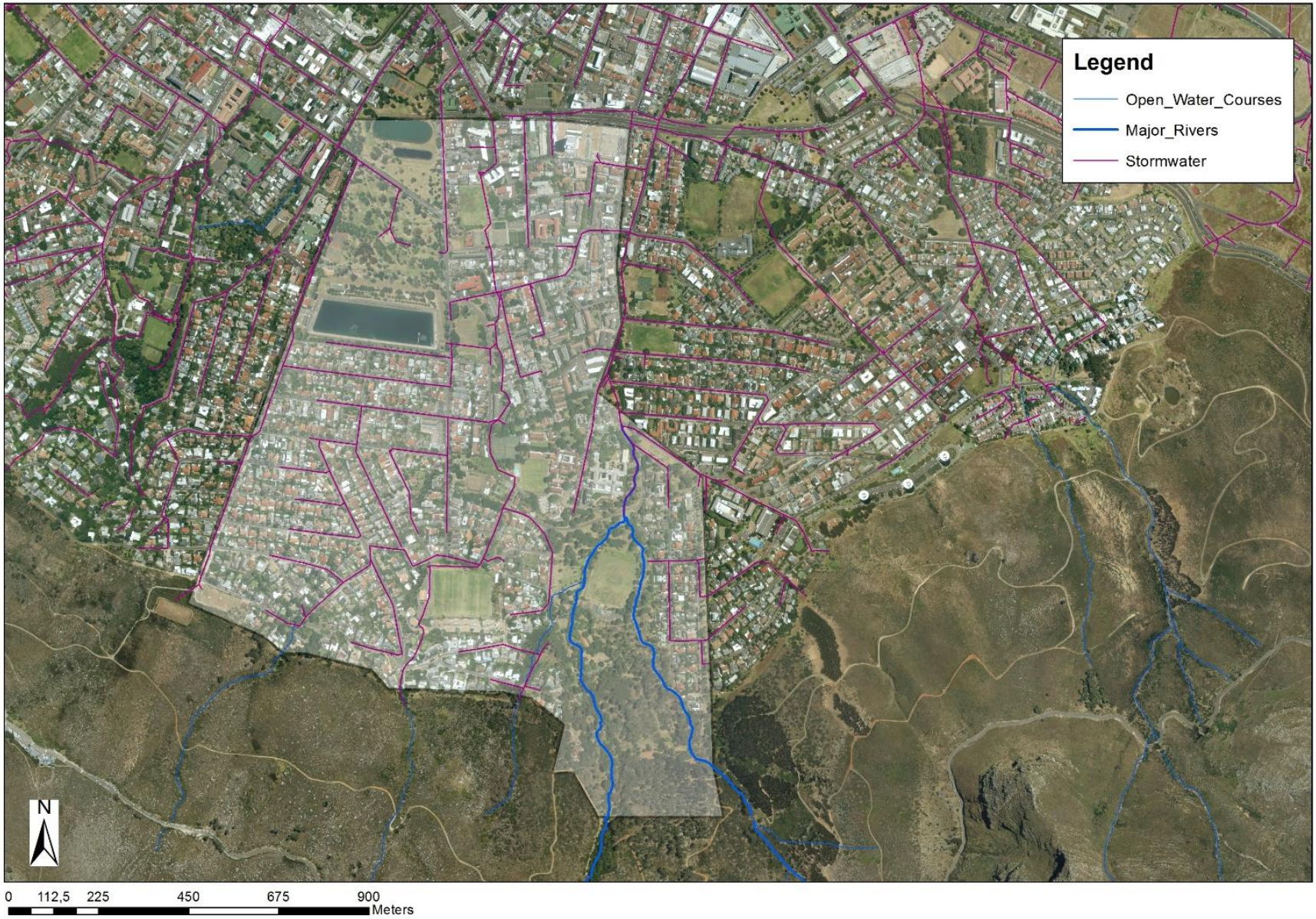

Figure 3.14: The flow of the on-site Camissa watercourses into the stormwater reticulation system (UCT GIS data, 2015).

3.3.5 Profile of Study Area: Heritage Analysis

As seen through the historical analysis, Oranjezicht and Deer Park has a rich heritage as it is among the founding areas of the Cape, which is largely due to the abundance of water within the area. Cape Town's CBD plays a very important role in its history and heritage, which may be sad or conflicting due to the onset of colonisation of the Cape and later the forced removals during the apartheid era. (Cape Town's CBD carries both current and historical economic, heritage, environmental, infrastructural and political significance as it is a place shared by many of the city's residents, but not necessarily shared equally.)

Deer Park, hosting the Platteklip stream near its western border, became deeply rooted in the cultural and spiritual practices of Capetonians through its unique water landscape (Jankes, 2014). An example of such a past practice is the daily journey of washer-women taking laundry to the Platteklip Stream to be washed (ibid; Brown & Magobo, 2009). Two large wash-houses were later constructed, as indicated by number 2 on Figure 3.15, in response to the pollution of the stream by washer-women (ibid). The site of the wash-houses has now been restored into a lodge (Figure 3.16).

Existing both on site and at various points in Cape Town are the Kramats of various Islamic scholars. In Cape Town, Kramats exist particularly in mountainous areas near streams highlighting a religious and spiritual relationship with water. Indicated as number 1 on Figure 3.15 and depicted in Figure 3.17, is the Kramat of Sayed Abdul-Haq Al-Qaderi, which exists in Deer Park. As stated by Jankes (2014), the site was also used by Rastafarians who perform a daily pilgrimage through Deer Park and up the mountain to the Platteklip Waterfall. The purpose of this pilgrimage is to cleanse their bodies of sin in the clean water of the Platteklip Stream (Jankes, 2014). In addition to the Platteklip Stream and other nearby streams forming part of the Camissa River System, the site hosts several historically significant spots (see Figure 3.15).

Figure 3.15: Water-related heritage on-site (UCT GIS data, 2015).

Figure 3.16: The restoration which took place on the site of the Platteklip Wash-houses (SANParks, 2017)

Figure 3.17: The Kramat of Sayed Abdul-Haq Al-Qaderi (Group Site Visit, 2017).

Oranjezicht itself is historically significant suburb as it was once a successful farmstead with an abundance of springs (Kotzé, 2011). The farm was owned by the van Breda family and its main income came from the sale of fruit and vegetables (ibid). On the property of this historic farmstead stands the Hurling Swaai Pump (indicated by number 5), which was one of the pumps constructed to extract groundwater supplied by the nearby springs (ibid). This pump has been declared a national monument, see Figure 3.18.

The Stadsfontein Spring, indicated as number 3, dates to 1686 and supplied Cape Town's first water pipe (Kotzé, 2011). The Stadsfontein Spring was covered with a vault in 1813, and later, in 1852, another collection chamber was constructed for the surrounding springs (Figure 3.19) (ibid). By 1859 a Bill was published, stating that springs, streams and other water sources within the Cape were under the ownership of the Board of Commissioners, making the water and land of little to no use to the farm owners (ibid). This also led to the ownership of the area's water by the municipality at the time. Currently the water of the Camissa River System falls under the municipality's jurisdiction as per Cape Town's water by-law (2010).

As stated by Kotzé (2011) and Brown & Magoba (2009), a series of reservoirs were constructed during the mid-1800s in response to a growing population. As such two significant reservoirs, namely Service Reservoirs Numbers 1 and 2, lay between Orange and Hoff Streets (number 6). While Reservoir 1 has been empty for many years, Reservoir 2 is filled with runoff from the Stadsfontein and Waterhof Springs and is used to irrigate the old Company Gardens and for fire-fighting (Kotzé, 2011). Water from the reservoirs on-site are also used to irrigate the Green Point Urban Park, an area approximately 2km from Oranjezicht. This water is also used in a few sanitation systems of buildings within the CBD. On the site of the Molteno Dam, which is indicated by number 4, also stands the city's first hydro-electric power station, namely Graaf's Electric Lighting Works, established in 1895 (Figure 3.20) (Mccain, 2015). In the site's immediate surroundings there is also recreational and aesthetic value placed on the scenic routes.

Figure 3.18: The Hurling Swaai Pump, located on the corner of Prince and Sir George Grey Streets (Group Site Visit, 2017).

Figure 3.19: Depicting a vaulted spring at The Field of Springs, Oranjezicht (Group Site Visit, 2017).

These socially and historically significant sites have the potential to form part of a water-heritage route within the area. Thereby providing water-cultural support to a future water sensitive suburb and city. These sacred sites along with supporting WSUD solutions can improve water- attitudes, relationships and practices. It is also a form of encouraging individual and community water- management and care.

Figure 3.20: A historic depiction of the Molteno Dam and Graaf's Electric Lighting Works (Reclaim Camissa, 2010).

3.4 Policy Analysis and Institutional Arrangements

As stated by Rabkin (2013), the National Development Plan (NDP) and National Framework for Sustainable Development (NFSD) provide key overarching frameworks that guide spatial planning and development in South Africa. In Cape Town, the Integrated Development Plan (IDP), which is mandated by the Municipal Systems Act 32 of 2000 (MSA), is a five-year plan outlining the City's development plans and budget (Rabkin, 2013). As per the MSA, the IDP is required to spatialise its plans, this takes the form of a Spatial Development Framework (SDF) (ibid). The SDF is a 10-year municipal plan, which aims to guide the spatial form of the city based on the strategies of integration; a balance between development and environmental concerns and economic accessibility (SDF Review, 2017). The SDF also gives rise to District Spatial Development Plans which governs the eight districts of Cape Town. The project site falls under the Table Bay District.

The National Water Services Act 108 of 1997 (NWSA) and National Water Act 36 of 1998 (NWA) provide the overarching frameworks that guide the strategies of the water sector. The Water Services Development Plan (WSDP), mandated by the NWSA, NWA and MSA, reports on the implementation of water services within Cape Town (WSDP, 2016). The plan reports on key metro projects and budgets of the preceding year (ibid). Existing water plans are not spatialized and discussed at a district or local level as its focus is the supply and demand at the metro scale.

The following sections will explore and review the national, provincial and municipal legislation and policies in relation to Oranjezicht and Deer Park. It will however focus more on local level plans such as the SDF and district plans as they are more applicable to suburb and precinct scaled projects. This section seeks to identify the ways spatial planning and water management can connect and harmonise. This section begins with a discussion of national policies which include the NDP, National Strategy for Sustainable Development 2011 – 2014 (NSSD), NWSA, NWA and the National Water Resource Strategy of 2013 (NWRS).

The provincial policies include the Land Use Planning Act 3 of 2014 (LUPA), Sustainable Water Management Plan (2017-2022 draft) and the Western Cape Climate Change Response Strategy (2014).

The municipal policies include the SDF, IDP, Water Services Development Plan (2013) and Water Demand Management Policy (2001). All the policies in this review abides by the Constitution of South Africa and the principles of the National Environmental Act 107 of 1998 (NEMA).

3.4.1 National and Provincial Plans and Strategies

Upon reviewing the national and provincial policies, it is evident that they aim to guide human behaviours concerning the interactions and development between human, nature and the built environment. These policies have also been developed with the aim of being translated into action (Cameron, 2014). South African water, climate change and spatial planning laws and policies are largely based on the concept of sustainable development and inclusivity which is evident in the goals and strategies of the NDP and NSSD. The concept of sustainable development used in South African policies and legislation is largely based on that of the Brundtland Report of 1989. Hence, the focus is on fulfilling current needs without compromising future generations (Brundtland Commission, 1987).

Legislation such as the NWA, NWSA and NWRS tend to have a clear anthropogenic view of water, hence it is recognised as a human right and seen as under the ownership of people. For instance, the NWA (36 0f 1998:1) recognises that water has been used in past discrimination and that "*…water is a natural resource that belongs to all people…".* The NWSA (108 of 1997:2) promotes the right to access basic water supply and sanitation services. As evident in municipal policies such as the Water Services Development Plan (2013) and Water Demand Management Policy (2001), the rights promoted in these Acts are interpreted in a way which encourages the supply of hard infrastructure. This happens despite the mentioning of WSUD in official provincial documents such as the draft Sustainable Water Management Plan (2017) and Climate Change Response Strategy (2014). The NWRS also recognises water as playing a central role in development and focuses on aligning economic and social strategies to ensure water is well managed according to IWRM principles.

It is evident in all the above-mentioned documents that the overarching principles guiding water appreciation at national, provincial and municipal levels include equity, integration and sustainability. However, there is still a strong focus on water as an economic asset to alleviate poverty by improving livelihoods (Cameron, 2014).

3.4.2 Municipal Governmental Policies

According to the Cape Town Metropolitan SDF (CTMSDF, 2012) its main purpose is to guide development and investment within the metro to achieve its desired spatial form. The CTMSDF's (2012) long-term vision is based on the principles of sustainable development as it implies inter and intra-generational justice. The framework uses the goals of economic growth and environmental sustainability as means to achieve sustainable development (CoCT, 2012). The CTMSDF addresses the research focus as it highlights the need for an improved quality of green and public open space systems, which along with other city attractions (such as heritage sites and tourist attractions), will increase quality of life (CoCT, 2012).

Both the 2012 and 2017 versions of the CMSDF take heed of water concerns through the Management of Urban Development Impacts on Natural Resources and Critical Biodiversity Networks Policy (Policy 23). Policy 23 of the CTMSDF (2017) encourages the protection and enhancement of biodiversity networks (TDA, 2017). This applies to the project area as it lies at the foot of Table Mountain and includes Deer Park which contains the critically endangered ecosystem and protected biodiversity statuses (TDA, 2017). As stated in the DSDF there is a need to better connect the biodiversity networks within the Table Bay District as well as the need to provide sensitive gateways to Table Mountain (CoCT, 2012).

According to Policy 24 of the CTMSDF (2017 draft), there is a need to "*reduce the impact of urban development on river systems, wetlands, aquifers, aquifer recharge areas and discharge areas"* (CoCT, 2012:189).

3.4.3 Findings & Discussion

South Africa has among the most progressive water laws in the world as it guarantees the right for all citizens to have access to water (Kemerink, Ahlers and van der Zaag, 2011). The above mentioned municipal plans and policies, for good reason, places great emphasis on water equity, water affordability, sanitation and its delivery to under privileged areas (Beck et al, 2016). In the current context of South Africa, and Cape Town being no exception, this type of service delivery is typically done through hard, grey infrastructural solutions. As stated by Armitage et al (2014), water systems have been developed and treated in a linear manner: water is sourced, treated, transported, distributed, collected, treated and disposed of; this process also highlights water's isolation from the citizens it serves. This process has resulted in technocratic solutions and a fragmented management system (Armitage et al, 2014).

Despite the acknowledgment of the potential of water being used as an innovative resource, within the reticulation system it is typically viewed and treated as a liability with potentially hazardous consequences. This is evident in the way the city's storm water is handled, which is through the direct transportation of it to the ocean. Storm water provides municipalities with the opportunity to uphold blue-green infrastructure principles through its recycling potential.

The Floodplain and River Corridor Management Policy (CoCT, 2009), allows for the change in Cape Town's water culture through blue-green solutions by means of the following objectives:

- the prevention of unwise use of floodplains;
- protection and enhancement of environmental goods and services;
- the integration of watercourses into the urban landscape and
- the promotion of sustainable development.

The City's 2017 Water Services and Development Plan on the other hand puts greater emphasis on current infrastructural solutions to the current water scarce conditions with little to no reference to blue-green infrastructural solutions. The Water and Sanitation Department also emphasises its alignment with the City's organisational goals with little to no reference to the implementation of green-blue infrastructure.

As stated by Armitage et al (2014) there is a fragmented institutional structure regarding the management of the city's water as different municipal departments are responsible for different components of the urban water cycle. For instance, stormwater management is the responsibility of the roads departments and water supply is separated from sewage collection, treatment and disposal (Armitage et al, 2014). This highlights the need for improved integration of municipal services (ibid).

While the existing laws, policies and frameworks (such as the CTSDF and IDP) allows for blue-green, innovative solutions to water scarcity, there is a gap in between the potential of spatial planning and water planning and management. This is evident in the fact that freshwater continues to flow into the stormwater reticulation system, as it does in Oranjezicht and Deer Park. Spatial planning therefore has the potential to better incorporate WSUD and green infrastructure within Oranjezicht. This should be done through collaborative planning and management between spatial planning and water departments.

The above mentioned municipal plans and policies highlights the importance of Oranjezicht, Deer Park and what is left of the CRS in relation to its biodiversity status and protected vegetation. The need to improve Cape Town's water-culture remains strong and can be done through a variety of context-specific, smart infrastructure solutions. However, little is said about the CRS and even less about the Platteklip Stream, in relation to the provision of water for citizens. This is an indication that the upper Platteklip Stream has great recreational and reverential potential, along with small scale blue-green infrastructural possibilities.

3.5 Opportunities and Constraints

This section summarises the key findings identified in the analysis of the site, which would inform the site intervention. The key findings include the connection of the stream to the stormwater reticulation system, the fragmentation in the management of different aspects of urban water and promotion of blue-green innovative solutions but the lack of visibility of it in spatial and water management plans.

Table 3.1 below summarises the various opportunities and constraints within Oranjezicht and Deer Park. These opportunities and constraints were identified in terms of different sectors to articulate the sectors interventions would fall within. Figure 3.21 depicts the key opportunities of the site.

Table 3.1: The Opportunities and Constraints within Oranjezicht and Deer Park (author's own)

SECTORS	OPPORTUNITIES	CONSTRAINTS
SOCIO-ECONOMIC	Public and semi-public open spaces providing good quality of life	Fresh water flowing beneath developments and infrastructure such as roads and businesses
HERITAGE	Located on Table Mountain – the 7th Wonder of the World	High heritage value may cause limitations to possible future developments
	Public and semi-public spaces with historical value for reverence	
	Water used by a variety of people for religious, spiritual and cultural reasons	
BIOPHYSICAL	Stream water enough for the site's public and semi-public spaces	Canalisation of river and streams into the stormwater system
	Presence of indigenous Fynbos	Threat of fire
	Mountainous areas receive a higher average rainfall – allowing for higher flow rates	Decrease in amount of water from streams due to drought
	Prospective green-infrastructure implementation	Pollution of stream: Possibly a result of homeless people living along stream
INFRASTRUCTURE	Well located in the CBD – in terms of road and transport infrastructure	Current infrastructure plays a role in the misuse of mountain water
	Highly functional – in terms of bulk and storm water reticulation systems	
	Prospect for implementation of WSUD	
INSTITUTIONAL	Constitution, legislation and policies allowing for innovative solutions to water scarcity	Fragmented management systems
	Application of integrated urban water resource management at a local-level	Lack of local area plan for the site
	Reuse and recycling of stormwater as stream flows into stormwater reticulation system	Water reports and strategies focus on consumption and not on blue-green solutions to climate change events

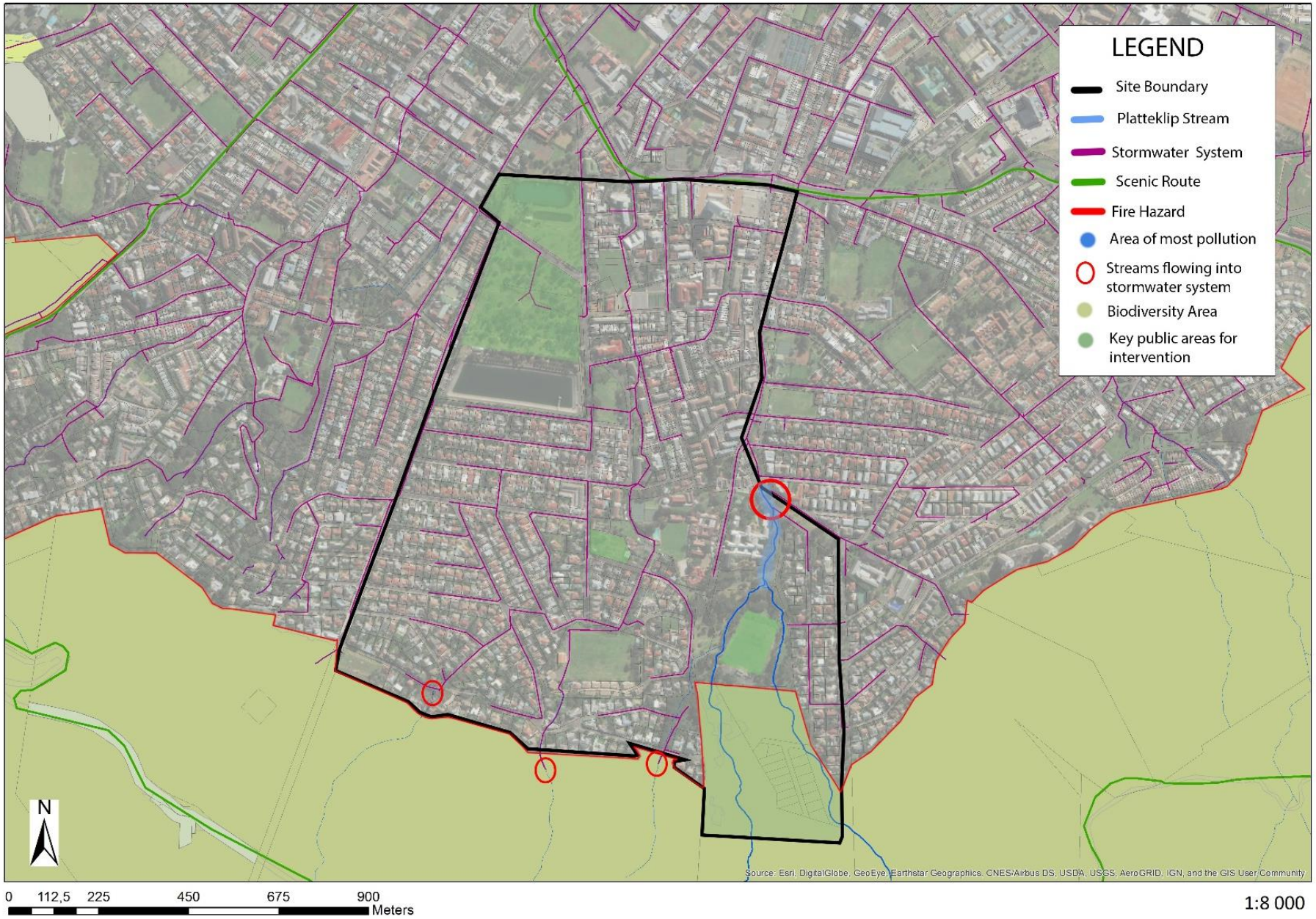

Figure 3.21: The key opportunities within Oranjezicht and Deer Park (author's own)

3.6 Conclusion

The purpose of this section is to analyse the status quo of the site in its capacity as a future water sensitive site to contribute to the improvement of Cape Town's water-culture. The key findings of this chapter highlight the potential for spatial planning to support a more water sensitive suburb through WSUD practices, green infrastructure and localised integrated urban water management.

The historical and heritage analyses highlight the vital socio-cultural aspect of both Oranjezicht and Deer Park. This also touches on the social justice responsibility of this site as it is well-located but a minority of the city's population uses it to its full potential. The biophysical and infrastructure analyses highlight the potential for public and semi-public green infrastructure and WSUD within the area.

The findings section further highlights the need and potential for WSUD within Oranjezicht by discussing the relevant policies. It also emphasises the need for inter-disciplinary and inter-governmental collaboration since the lack thereof results in the fragmented governance. This links back to the need for localised IUWM. Spatial planning has the potential to use a variety of developmental tools to improve social and environmental conditions (Nadin, 2007). Within Oranjezicht, it has the potential to use soft infrastructural tools such as WSUD to guide and improve urban water culture within the suburb. Hence, serving as an example to the wider city region.

Chapter 4

4 Spatial and Policy Interventions

4.1 Introduction

The previous chapter analyses the spatial and political aspects of Oranjezicht to identify the key challenges and the potential of the site. Oranjezicht and Deer Park contains potential to reimagine and redesign water relationships within the area and its surrounds. Three key findings in chapter three form part of the heritage, infrastructural and institutional spheres. These include the potential to add value to the site's historical and heritage elements; the potential for WSUD because of streams being directed into the stormwater system and lastly the need for collaboration within and between sectors and departments of government.

Envisioning sustainable, water-sensitive futures for urban areas is an increasingly important aspect of spatial planning. The field of spatial planning also allows for the reimagining of a water-sensitive future through spatial and legislative interventions. As climate change conditions worsen, experts predict the worldwide increase in freshwater scarcity (McKie, 2015). With environmental conditions deteriorating and the effects of climate change rapidly worsening, this is the ideal time to recreate and restore the socio-environmental relationship.

The intent behind this research project is to reimagine the future of water in Cape Town, using Oranjezicht and Deer Park as small-scale intervention and catalyst sites for improved water sustainability. These interventions take place at a policy level, which would then translate into the on-site interventions.

This chapter begins by presenting the purpose of the research and describes the vision for the site. It then moves on to the aims, objectives and strategies identified to achieve the said vision. The second section of the chapter contains the spatial and policy interventions put forward to achieve an improved urban water-culture within the site and general city region. Firstly, the proposed spatial interventions aim to better restructure public and semi-public spaces in ways which prioritises water flow. Secondly,

recommendations are made to amend policy to ensure better consideration of relatively unused water bodies more holistically in the future.

4.1.1 Purpose

The purpose of this chapter is to show the potential urban spatial planning has, to effect socio-cultural water-relations in Oranjezicht and Deer Park. This is due to the location of the Platteklip Stream, the Field of Springs, a small-scale water treatment facility and dams (see numbers 1, 4, 5 and 7 respectively on Figure 4.1). The water consciousness within Cape Town and the Western Cape, has increased because of the drought and increasingly stringent water restrictions (personal communications). There is however a need to improve the human relationship with water within Cape Town. This is evident in the fact that the Mayor of Cape Town felt that the city's top 100 water users had to be published, as water restrictions were not being obeyed.

As stated by Armitage (2017), the highest water consumers within the Cape are those living in wealthy neighbourhoods, with lush gardens and pools (Nicolson, 2017).

4.1.2 Vision for Oranjezicht

The future image of Oranjezicht is quite like its role of the past, which is recreating it and allowing it to once more, become Cape Town's inner-city water hub. The idea behind this is having the site become a metaphor for the way in which water should be used i.e. in a cyclical manner. This water hub will contain the heritage, environmental, social and water conscious values to be upheld firstly, within Oranjezicht and eventually within the entire metropole. This would be done by highlighting the importance of natural systems, bioprocesses and incorporating WSUD technologies where suitable. Having a water hub located within a high-income, privileged residential area in Cape Town's CBD serves as an advantage since it encourages water consciousness to become embedded in residents' lifestyles.

This project be a proposed first step towards a more water-friendly Cape Town. Due to the small scale of the project, its short-term vision is solely within the site boundaries while the medium to long-term visions go beyond its boundaries.

The short term (5 – 10 years) vision for the site is recreating it into an internal water hub where resident and visitors to the site learn the value of natural water systems and are encouraged to incorporate WSUD technologies at a household scale.

The medium term (10 – 15 years) vision for the site includes going beyond the site's boarders, into the CBD and beyond. The idea is to extend the water routes within the area to the broader CBD and eventually connecting it to water bodies and rivers throughout the metropole.

4.1.3 Aims and Objectives

The aim of this project is to demonstrate how spatial planning can better incorporate aspects of WSUD and integrated urban water management into its realm. It therefore encourages collaboration within and between a variety of spheres. Within the social realm, this research project aims to use spatial planning to encourage the viewing of unused water courses as natural bodies holding great potential to effect sustainable, water-conscious change within urban spaces and urban culture. This is a much-needed concept due to the history and current state of water simply being managed at various scales for consumption and usage by people. The overall idea is to shape the ways in which water is perceived thereby creating a positive, sustainable water-culture within Oranjezicht, surrounding areas and over time, the city. The key objectives of this project include:

- Promoting the use of WSUD within Oranjezicht and Deer Park;
- Promoting the usage of Oranjezicht as an environmental, heritage and social water hub;
- Planning for a healthier water suburb through the actions of public and semi-public spaces;
- Enhancing and centring water concerns within the spatial planning and built environment sphere;
- Encouraging the cohesion of departments within local government;

4.1.4 Key Strategies

There are three overall strategies in which the above-mentioned objectives could be achieved, this includes Reverence, Education & Practice and Policy. These strategies guide and is applicable to both spatial and non-spatial interventions.

Reverential Strategy

This strategy aims to encourage the appreciation of water from ecological, environmental, cultural and historical perspectives. It uses the site's environmental and heritage aspects, such as Deer Park, the washhouses, Kramat, old water infrastructure, etc., and location of the Platteklip Stream's headwater to create a water route within the area.

Strategies for Education & Practice

- Location of an educational water treatment centre at the site of the Molteno Dam.
- Creating space for the practice of WSUD solutions within existing public and semi-private spaces.
- Enhance the educational aspect of the Field of Springs to become an educational water site.
- Encouraging partnerships with schools, public and semi-public institutions.

Policy Strategies

- Enhance the integration of the relevant municipal departments through the principles of good governance and IWRM.
- Encourage the unification of the various water departments and encourage collaboration with civil engineering and spatial planning.
- Improved Collaborations between governmental bodies and private sector.
- Create a local area IUWM framework which corresponds with the regional one.
- Water Enjoyment Index: can be created through a qualitative local area water report.

4.2 Interventions

The key to transforming water-culture in Oranjezicht and eventually Cape Town is having a supportive policy framework. This allows for abiding by new water recommendations in the long term. Currently, the spatial planning, and water departments work on separate mandates. Within the water sector, departments are split resulting in fragmented water management. The first section proposes spatial interventions while the second section contains the proposed policy recommendations and amendments to support the proposed spatial interventions.

4.2.1 Spatial Interventions

The following spatial interventions are based on the key findings from the previous chapter. It aims to enhance the socio-cultural aspects of water appreciation. The spatial interventions within this section follows the strategies of reverence, education and practice. This section draws inspiration from the water hub concepts at Emroy University and the future water hub as proposed by the Western Cape Government. The former contains an on-campus water hub in which water is recycled for on campus uses as well as a research facility (Emroy University, 2015). The latter is a plan which is still underway, the proposed idea vision is the creation of a regional water hub in Franschhoek (Winter, 2016).

4.2.1.1 Concept and Vision

The vision for this site carries the three principles of reverence, education and practice. The creation of a water route throughout the site is key to the spatial interventions. The goal is to connect the various public open spaces and heritage spots to bring more attention to the area and city's water history and enhance the current thinking around water. This idea is strategically located within a residential suburb in Cape Town's CBD to recreate and improve the water-culture at a local level.

Because of the city's water history, the goal is to use Oranjezicht as the first step in allowing Cape Town to become a water hub. It should become the city where sustainable water usage is learnt and

practiced. The overall concept (as can be seen in Figure 4.1) is one of connectivity. The water awareness route is what connects the various precincts containing sustainable, water-conscious activities.

These interventions are based on the key findings of the previous chapters. Specific sites were selected which hold water-significance, these include: the Platteklip Stream headwaters flowing through Deer Park; Van Riebeek Park; the Field of Springs site (including Homestead Park and the Oranjezicht City Farm); the site of the Molteno Dam; De Waal Park and the site of Service Dams 1 and 2. These sites will host different activities relating to reverence, education or practice and will be connected by a green network or water route.

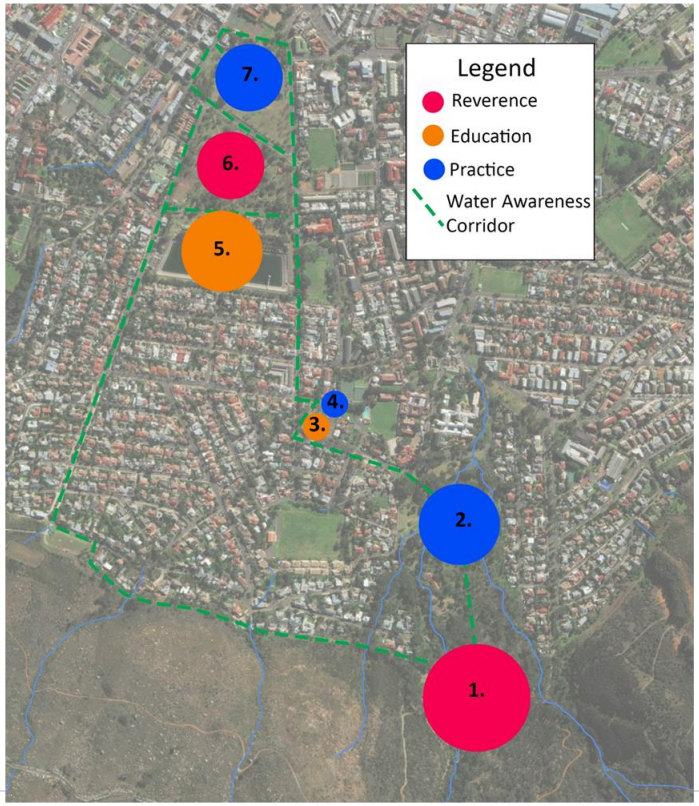

Figure 4.1: A conceptual map of the site showing connectivity as its main theme, as well as the spaces it's grounded in.

4.2.1.2 The Platteklip Stream

This area is represented as number 1 on Figure 4.1. The headwater of the Platteklip Stream and Deer Park has great potential to become a site for water reverence as it is remains relatively unaltered by people due to its protection status. The site contains heritage aspects such as the Platteklip Washhouses and the Karamat of Sayed Abdul-Haq. This portion of the site also contains old water filtration infrastructure which could either be upgraded or altered to be used in creative ways for the benefit of the public. Since this site is already a public recreational area, it should be upgraded to be a key reverence point of the proposed water route. The reverential aspect of the site allows people to visit and celebrate water.

Purpose:

- Public water reverence space
- Recreational area
- Historical significance and educational area

Required Action:

- River clean up (due to its polluted state)
- Upgrading of recreational spaces (such as the picnic are)
- City should work in conjunction with South African National Parks (Sanparks)
- Employment of WSUD technologies as river flows into the stormwater system. This also applies to the minor open water courses on-site.

4.2.1.3 Van Riebeek Park

Located near Deer Park and indicated as number 2 on Figure 4.1, this park holds great potential for small-scale WSUD technologies. Based on good WSUD principles, it is a good location for low-cost, environmentally sustainable water retention projects, such as a series of bioretention schemes. The fact that the park lies near the Platteklip Stream and currently has a recreational function enhances its potential for WSUD. This also encourages collaboration between various sectors to ensure good design. The sloping nature of the park also encourages innovation as this would also allow filtered stormwater to flow into the system. Thereby, making stormwater treatment occurring downstream easier.

Purpose:

- Fulfilling the principles of reverence, education and practice as it is an aesthetically pleasing, highly functional area.
- Displaying environmentally sustainable water filtration processes.
- By distilling water upstream, it allows for cleaner stormwater to flow downstream making its treatment less intense.

Required Action:

- Work in partnership with Sanparks, DEA&DP and interested and affected parties within Oranjezicht and Vredehoek.
- Collaboration with urban designers and water experts.
- Ensure indigenous vegetation is planted should more vegetation be required for this area.

4.2.1.4 Oranjezicht City Farm, Field of Springs and Educational Precinct

The Oranjezicht City Farm is indicated as number 3 on Figure 4.1. This area has great potential to, and to a degree already embodies the principle of sustainable water practice through the practice of urban agriculture. This is because of the Oranjezicht City Farm (OZCF) located adjacent to the Field of Springs, hence having potential for recycling water and using it in urban agriculture.

The Field of Springs site (number 4 on Figure 4.1) has the potential to become an educational space and tourist hotspot due to its heritage value. Regular guided tours should be allowed within the Field of Springs for educational purposes. It is also proposed that the principles of education and practice are extended to educational precincts within the area which have yet to implements WSUD technologies. The OZCF and participating schools should facilitate the relationship between sustainable, (grey) water practices in urban agriculture. This option should be available to all schools within the area. In extreme drought conditions, such as the current state of Cape Town, this site should be used as a public water collection point.

Purpose:

- Springwater education through the upgrading of the Field of springs.
- Education and awareness around sustainable water practices by the OCF and school precincts.

- Greywater education and practice

Required Action:

- Work in partnership with OZCF and surrounding schools.
- Implementation of greywater technologies

4.2.1.5 Molteno Dam Site

Indicated as number 5 on Figure 4.1, this site is a water storage facility and is currently undergoing construction to create a small-scale water treatment plant (personal communications). The structure on-site also contains heritage value as it was constructed during the 1800s indicated as a heritage structure on Figure 4.2). The treatment plant is currently undergoing construction. It is proposed that the existing treatment facility should be upgraded along with the historical hydroelectricity producing functions. This site has great potential for educational purposes. The water treatment and hydroelectricity plant should host guided tours available to the public as well as schools.

Purpose:

- The key principle of this site is education.
- The small-scale water treatment, hydroelectricity production and research facilities all serve as examples of local level water efficiency.
- Historical buildings on-site also serve as having heritage significance.

Required Action:

- Working in partnership with the local and provincial governments because of the heritage significance of the dam and building on site respectively.
- Partnering up with tertiary academic institutions for research purposes.

4.2.1.6 De Waal Park

This site should maintain its public open space status as it forms part of the metropolitan open space system and considered as a provincial heritage resource (number 6 on Figure 4.1). However, it is proposed that shelter-providing structures, which comply to the aesthetics of the site, be incorporated in the park. This is to encourage on-site water conventions for government officials, private stakeholders, school field trips or even social events such as concerts. The existing function of this park is key as it is a well-used public space, hence it would also be a key point for people walking the water route of Oranjezicht.

Purpose:

- Education and reverence
- Social integration

Required Action:

- Work in partnership with local and provincial government, urban designers, community groups and interested and affected parties.

4.2.1.7 Site of Service Dams 1 & 2

Located opposite De Waal Park, this site is suited for a small scale stormwater recycling plant (number 7 on Figure 4.1). The functioning dam on this site typically serves the fire department and will be encouraged to maintain that function while increasing its volume of water storage. This will be a result of recycling and capturing treated stormwater.

Purpose:

- Education, awareness and water sensitivity
- Employing WSUD principles

Required Action:

- Get consent for the implementation of new technologies in public open space 2 zoning.
- Partnering with local and provincial government because of its heritage significance. This includes environmentalists, engineers and water experts.
-

4.2.1.8 The Water Route

One of the key features of this site is the access route connecting the various significant water-heritage and innovative sites within Oranjezicht and partially Vredehoek. This route is an NMT/blue-green route starting at Deer Park as can be seen Figure 4.2, extending around the park, going down past the Karamat and washhouse site and through van Riebeek Park. It continues into Sidmouth Ave to the OZCF, Homestead Park and the Field of Springs. The route then runs back into Upper Orange St and extends down to the Molteno Dam, De Waal Park. This route would also include minor heritage stops such as the Hurling Swaai Pump in Prince St (indicated as a heritage structure on Figure 4.2). The main purpose of this water route is to create awareness around the water history of Cape Town and promoting the importance of current and future water sustainability.

4.2.1.9 Further Recommendations

Smaller streams within the area should not be ignored and since these minor streams also run into the stormwater system, it should also be exposed to bioretention interventions. This should be done to filter the water so that the stormwater treatment can be less intense. Alternatively, if the water is up to the blue drop standard, it can be directed to the Molteno damn where in drought situations, it could be allowed into the bulk water reticulation system.

All public and semi-public open spaces within the area should contain water sensitive activities. This could range from practicing water sensitive urban agriculture to capturing, storing, treating, recycling and using rain water. The methods used to achieve these outcomes should ideally mimic natural processes and not be infrastructure or construction intensive solutions. This should also lead to natural blue-green infrastructural solutions to be encouraged at the household level. The implementation of grey water piping is encouraged on private and semi-private properties and would hopefully lead to its implementation throughout the site and eventually the city.

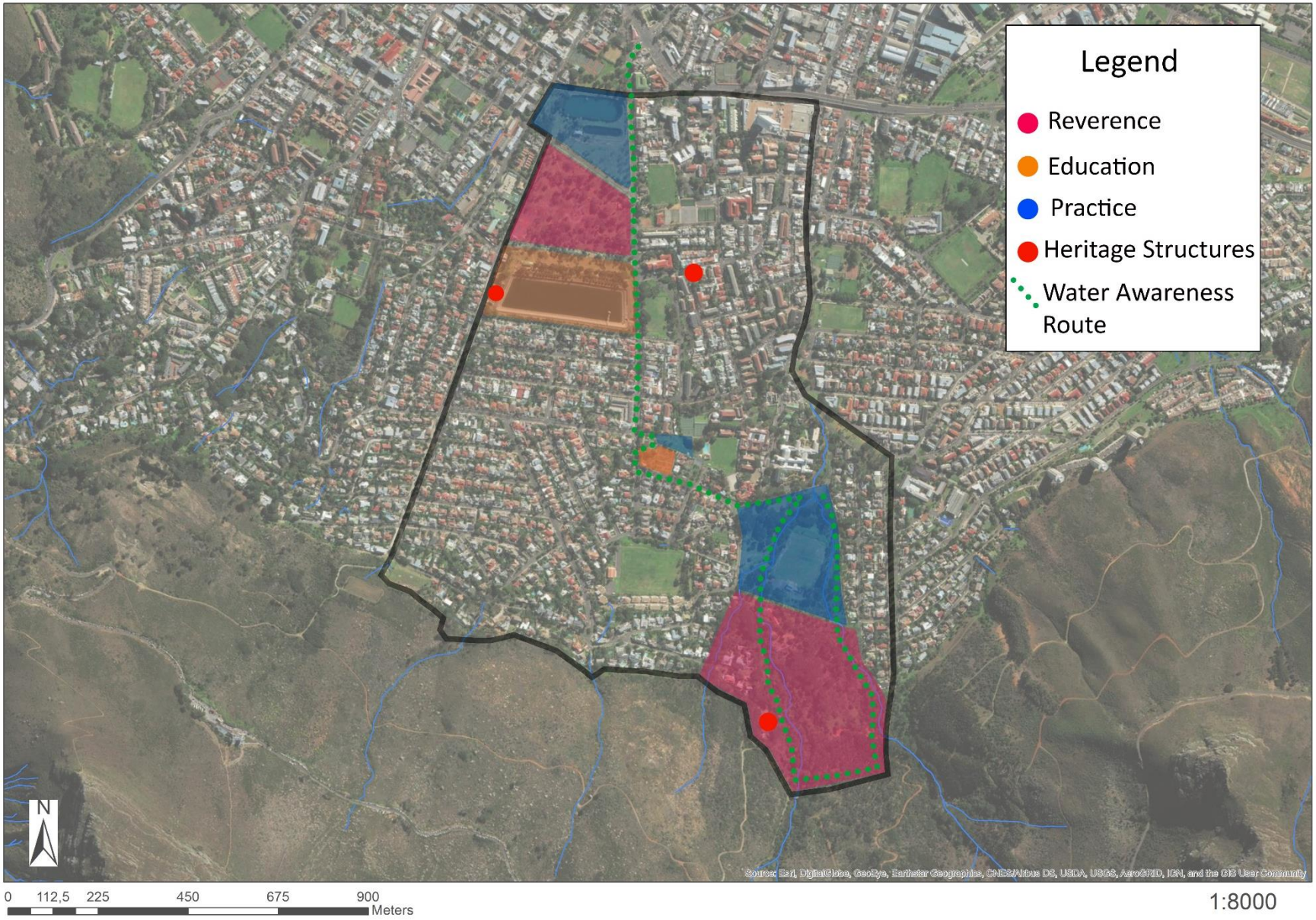

Figure 4.2: Showing the intervention map for the site (author's own)

4.2.2 Policy Interventions

The policy interventions in this section focuses on the management of water bodies to enhance its socio-environmental relationship. It does not apply exclusively to Oranjezicht as its principles can be applied to or act as a catalyst for the CBD and beyond.

4.2.2.1 Water Reverence Report

This is a proposed qualitative, five-year water report done to research and analyse the relationship between users of the site and water or water bodies such as rivers, streams or dams. This report would typically be done per district. However, suburbs containing rivers with high volumes, streams or dams should develop a suburb report. This report should be based on the *OECD Guidelines of Measuring Subjective Well-being* (Organisation for Economic Co-operation and Development, 2013:10). These three principles are also used in the World Happiness Report to measure and understand happiness (Helliwell, Layard & Sachs, 2017).

This type of research is subjective but these principles can be measured to get an overall idea of the current relationship with water within an area. The principles to be used would include:

- Life Evaluation: a reflective assessment regarding a person's history with a water body or water in general.
- Affect: one's feelings or emotional state regarding water.
- Prosperity: the sense of good meaning and purpose regarding the usage of water. This could be a reverential or consumptive usage.

These qualitative water reports should be standalone reports for the metropolitan region. This type of research should be done by an independent group in partnership with the spatial planning and water departments within the City of Cape Town. The Water Reverence Report should inform district and metropolitan spatial planning; i.e. the DSDF and MSDF. If done correctly and with integrity, it also has the potential to contribute to the public participation aspects of district and metro spatial planning.

4.2.2.2 Localised Integrated Water Care Framework

Carrying the principles of reverence, education and practice, this proposed framework is required to set out the responsibilities within the public and private sectors regarding site specific water management and water planning. This is to be done at the district or suburb level depending on the size and amount of water bodies and water within the area. For instance, in sizeable, water-logged areas such as Mitchells Plain and Phillippi, a suburb scale framework might be more useful. Within the CBD however, a district level framework might be more useful as the amount of open water sources and groundwater is less and suburbs are relatively smaller.

This framework will contain an abridged version of the Reverence Report, stating only the main points and key findings. The purpose of this Framework is to unify the maintenance and management of water usage and water bodies within a specific area. This framework also encourages the usage of innovative and sustainable water technologies, design and spatial solutions to potential scarcity or flooding. This framework should ideally be operated by the municipal government's Department of Water and Sanitation, in conjunction with spatial planning and environmental management departments. This should be done to inform district and local level developments and land uses.

Within Oranjezicht and Deer Park, this Framework would complement the district and local area plans, such as the Table Bay District Spatial Development Plan. It would also have to be used by developers in informing their proposals.

4.2.2.3 Water Planning in Education

Education is an important tool in addressing a variety of water issues and innovation. This mainly lies within the spheres of science and engineering, which could result in the knowledge of innovative water technologies but the lack of implementation skills as is the case with WSUD (Armitage et al, 2014).

Ideally, water education should start at primary school level in greater depth regarding its quality and quantity. The focus of this implementation strategy is to highlight the need for water planning at a tertiary education level. Current City and Regional Planning courses in Cape Town focuses on issues around infrastructure,

economics, human settlements and the natural environment, but not enough attention is given to the relationship within and between water and spatial planning.

The proposal here is to include more detailed water education within all levels of schooling as well as in almost every built environment course. This provides schools within Oranjezicht with the opportunity for water-education innovation. This remains relevant since water shapes all aspects of life and the built environment should be no exception.

This strategy aims to enhance water-education by providing sites which encourage research and innovation. Various aspects of the site should host opportunities for research and innovation within the sphere of urban water planning or WSUD. For instance, the implementation of stormwater recycling and WSUD at the service dams and Van Riebeek Park respectively, holds potential for research and innovation.

4.2.2.4 Amendments to Management of Urban Stormwater Impacts Policy

The City of Cape Town's WSUD strategies are based off international experiences, while embedded in the CoCT Management of Urban Stormwater Policy (2009). The reason for the former is a result of the lack of skills and expertise in the field of WSUD within the South African context (Armitage, 2014).

The amendments to the Management of Urban Stormwater Impacts Policy should place greater emphasis on the need for WSUD implementation and practice by supporting the creation of a localised WSUD policy should be created. It should also highlight the need for collaboration between urban planning, urban design and stormwater departments.

4.2.2.5 Amendments to By-Laws

As stated by CoCT's Spring Study (2016) there are no municipal by-laws governing the use and distribution of spring water. This results in fewer regulations monitoring its usage, as is the case with the Oranjezicht springs. A by-law has been created to regulate the use of

treated effluent for irrigation (CoCT, 2016). This by-law holds potential for adaption to include the usage of spring water (ibid).
This dissertation also proposes the stormwater by-law be amended to allow the recycling of stormwater to use in a proposed grey water system for non-potable use. Overall, there should be greater integration between water and stormwater departments as well as between all water departments and spatial planning.

4.3 Conclusion

The purpose of this chapter was to identify the role urban planners play in identifying possible interventions for the improvement of the water-culture within Oranjezicht. These interventions were grouped into spatial and policy interventions. The combination of several small spatial interventions throughout the site contributes to the goal of Oranjezicht becoming an inner-city water hub, thereby becoming a satellite campus for the regional water hub to be constructed in Franschoek, Western Cape. These smaller interventions take place within public or semi-public spaces and promotes water sensitivity through reverence, education and practice of WSUD. While spatial policies aim to encourage an improved water-culture, the policy interventions aim to encourage collaboration between the water sectors and spatial planning.

A key point of this chapter is that there needs to be collaboration between and within different sectors for the proposed interventions to be successful. Another key element, which has been confirmed by Winter (2017), is that there is no one solution to the current water crisis but rather, it is key to raise awareness around the different possible solutions. This should be done through education and demonstration of the WSUD principles.

Due to the residential nature of the site, it is important that the various educational facilities provide information for implementation of WSUD principles on a household level. The creation of unity through education and practice is imperative in the current state of Cape Town. If done correctly, it would be the most sustainable solution to the water crisis.

Chapter 5

5 Implementation of Water Sustainability Projects

5.1 Introduction

In seeking to achieve a new and improved water-culture within Oranjezicht, reverence, education and practice were identified as three key strategies. These strategies informed policy and spatial interventions to take place in Oranjezicht, Deer Park and a section of Vredehoek. The purpose of this chapter is to show how Chapter 4's interventions are to be carried out. The implementation projects are divided into spatial and policy implementation projects. A detailed table is also provided, describing the relevant legislation, actors, timeframes and funding responsibility.

The severe drought Cape Town is undergoing has resulted in residents and officials trying to adapt to a new norm by urgently searching for solutions. Therefore, it is to be noted that the interventions stated in the previous chapter and the implementation project to be discussed are not ideal for extreme disaster situations. These projects attempt to draw attention to the lack of appreciation of the city's historical water sources and complacency of relying on one type of water source for all needs. The complacency within Cape Town has been rife and it is evident in the fact that some of the flow of river and spring water within Oranjezicht and Vredehoek has been left to flow into the city's stormwater system. These projects show the ways in which spatial planning could encourage an improved behavioural change towards water.

This chapter first discusses the implementation of spatial interventions while the second section addresses the implementation of the proposed policy interventions.

5.2 Implementation of Spatial Intervention Projects

5.2.1 Platteklip Stream

The reverential vision for the Platteklip Stream project is spatially guided by the CTSDF and Table Bay District Plan. The City's Environmental Management and Spatial Planning and Urban Design Departments are lead actors in this project as the site may need redesigning to cater for higher volumes of visitors.

This is a long-term project (10 – 15 years) with funding from municipal government, SANParks and the Recreation and Parks Department (Table 5.1).

5.2.2 Van Riebeek Park

The vision for this park is that it becomes a recreational facility with WSUD. Guiding policies include the Table Bay District Plan and Roads and Stormwater Policy. The City's Spatial Planning and Urban Design Departments are key actors in this project as the site requires redesigning to implement WSUD projects such as constructed wetlands, vegetated swales, bio-retention tree pits, or rain gardens (Figure 5.1).

This is a long-term project with funding from the CoCT Spatial Panning and Urban Design Department, CoCT Environmental Management Department, CoCT recreation and Parks Department and SANParks (Table 5.1).

Figure 5.1: Examples of the implementation of WSUD techniques (Wellington City Council, 2013)

5.2.3 Field of Springs

This site carries an educational vision, hosting more regular guided tours of the site to educate people about spring water. In extreme drought conditions (such as the current conditions in Cape Town), this site should be a public water collection point. Key guiding policies include the groundwater policy and Water By-Law. This is a medium-term (5 – 10 years) project, with the CoCT Dpt playing a key role. This project also forms part of the proposed educational projects (Table 5.1).

5.2.4 Molteno Project

These precincts include De Waal Park, the Field of Springs, the Molteno Project and the Service Dams Project. As stated Chapter 4, the construction of a small-scale water treatment plant is currently underway on the site of the Molteno Dam. There is further opportunity to create a small-scale hydroelectric plant, which could result in a self-sustaining small scale, water treatment plant. The guiding policies include the water Demand Management Policy and Table Bay District Plan. The key actor is the Water and sanitation Dpt. This is a medium-term project with the CoCT Environmental Management, Spatial Planning & Urban design and water and Sanitation departments (Table 5.1).

5.2.5 Service Dams Project

The vision for this site is having the two service dams as model sites for stormwater recycling. It should also serve as an educational facility where WSUD technologies are tested and visitors are educated about this topic. The guiding policy documents would be the CTSDF, IDP and Water By-Law. This is a medium-term plan, with the main funders being the Spatial Planning & Urban Design, Environmental Management, Department of Water and Sanitation. and the Recreation & Parks Departments. SANParks is also a key funder in the implementation of this project (Table 5.1).

5.2.6 Educational Precincts

The main purpose of having this kind of intervention is to encourage the change in urban water-culture. This project will incorporate all levels of educational institutions. The City should work in partnership with tertiary education institutions as they could serve as research, development and innovation teams for water research. On-site educational programs will be targeted at three key level; primary school, high school and tertiary level education. This is a long-term project, with SANParks and departments within municipal government being key funders (Table 5.1).

5.2.7 Water Route

The purpose of the implementation of a water route is to draw attention to and celebrate water within Oranjezicht and Deer Park. To achieve this, the CTSDF and Table Bay District Plan must be consulted as this route could form part of the metropolitan open space system. The implementation of this project has a long-term timeframe (10-15 years). The implementation of several other spatial intervention should take place first to establish important sites within the area. The designing of a water route should take place once people frequent the site often. The desire lines of the site visitors should be tracked and studied. An official water route should be developed based on the tracked route if it complies within water-sensitive and environmentally sustainable principles. The key actors of this project include the both the Water and Sanitation, and Spatial Planning and Urban Design Departments.

Table 5.2 Summary of the implementation of spatial interventions (author's own)

Project	Guiding Policies & Legislation	Responsible Parties (Existing Institutions & Actors)	Timeframe	Funding
		Spatial Interventions		
Platteklip Stream	• CoCT Spatial Development Framework (CTSDF) • IDP • Roads & Stormwater Policy • Deer Park Spatial Development Plan • Stormwater and River Management Strategy • Floodplain and River Corridor Management Policy • Parks Development Policy	• **CoCT Environmental Management Department** • Recreation & Parks Department • City of Cape Town • South African National Parks (SANParks) • Oranjezicht Ratepayers Association • Department of Environmental Affairs & Development Planning (DEA&DP)	Long Term: 10-15 years	• South African National Parks (SANParks) • CoCT Environmental Management Dept • CoCT Recreation & Parks Department
Van Riebeek Park	• CTSDF • IDP • Roads & Stormwater Policy • Deer Park Spatial Development Plan • Stormwater and River Management Strategy • Floodplain and River Corridor Management Policy	• **City of Cape Town: Spatial Planning and Urban Design** • South African National Parks (SANParks) • CoCT Environmental Management Department • CoCT Recreation & Parks Department • DEA&DP • Community • CBOs • Oranjezicht Ratepayers Association	Long Term: 10-15 years	• City of Cape Town: Spatial Planning and Urban Design • South African National Parks (SANParks) • CoCT Environmental Management Department • CoCT Recreation & Parks Department
Field of Springs	• Groundwater Policy • Water By-Law	• **CoCT Department of Water and Sanitation** • City of Cape Town • CoCT Environmental Management Department • Oranjezicht Ratepayers Association • Oranjezicht City Farm (OZCF)	Medium term: 5 - 10 years	• CoCT Department of Water and Sanitation
Molteno Project	• CTSDF • IDP • Table Bay District Plan • Water Demand Management Policy	• **CoCT Department of Water and Sanitation Department** • Department of Energy • CoCT Economic Development Department • DEA&DP • City of Cape Town: Spatial Planning and Urban Design • South African National Parks (SANParks) • CoCT Environmental Management Dpt	Medium term: 5 - 10 years	• CoCT Environmental Management Department • City of Cape Town: Spatial Planning and Urban Design • CoCT Department of Water and Sanitation
Service Dams Project	• CTSDF • IDP • Water By-Law • Cape Town Municipal Planning By-Law	• **CoCT Department of Water and Sanitation** • CoCT Economic Development Department • CoCT Environmental Management Department • City of Cape Town: Spatial Planning and Urban Design • DEA&DP	Medium term: 5 - 10 years	• City of Cape Town: Spatial Planning and Urban Design • CoCT Department of Water and Sanitation • DEA&DP
Educational Precincts	• CoCT Social Development Strategy	• **City of Cape Town: Spatial Planning and Urban Design** • 4 Western Cape Universities • Water Related NGOs & CBOs • Cape Town Partnership • Department of Basic Education • Department of Higher Education • South African National Parks (SANParks) • CoCT Environmental Management Department • CoCT Recreation & Parks	Long Term: 10-15 years	• City of Cape Town: Spatial Planning and Urban Design • South African National Parks (SANParks) • CoCT Environmental Management Department • CoCT Recreation & Parks
The Water Route	• CTSDF • Table Bay District Plan	• **CoCT Department of Water and Sanitation** • Central City Improvement District. Communications Department • Water Related NGOs & CBOs • Cape Town Partnership • City of Cape Town: Spatial Planning and Urban Design • DEA&DP	Long-term: 10-15 years	• City of Cape Town: Spatial Planning and Urban Design • CoCT Department of Water and Sanitation

*Key actors are bold at the top of the list

5.3 Implementation of Policy Interventions

5.3.1 Water Reverence Report

This purpose of this proposed report is to analyse the relationship between site users and water or water courses. This report is informed by a number of national, provincial and local policies and legislative frameworks (Table 5.2). Key actors include CoCT Department of Water and Sanitation, Spatial Planning ad tertiary institutions. This type of research should be done by an independent group in partnership with the spatial planning and water departments within the City of Cape Town. This would ideally be suited for tertiary institutions as it encourages research and education within the field of urban water-culture. The Water Reverence Report should inform district and metropolitan spatial planning. This project holds a short-term timeframe and would be funded by the City and public-private partnerships.

5.3.2 Localised Integrated Water Care Framework

This proposed framework is required to set out the responsibilities within the public and private sectors regarding site specific water management and water planning. Its purpose is to unify the management and maintenance of water usage and water bodies. This framework would be operated by CoCT Department of Water and Sanitation, Spatial Planning and Department of Environmental Affairs & Development Planning Departments. This would inform district and local level developments and land uses. This is a short-term framework (0-5 years), funded by local government (Table 5.2).

5.3.3 Water Planning in Education

The purpose of this strategy is to encourage water-sensitivity within all levels and phases of the formal education system, hence resulting in an improvement in urban water-culture. This long-term strategy highlights the need for water planning at a tertiary level and within all aspects of the built environment.

This is a long-term strategy funded by local government and SANParks. Key role players include the Department of Water and Sanitation and tertiary institutions (such as University of Cape Town and Cape Peninsula University of Technology).

5.3.4 Amendments to Management of Urban Stormwater Impacts Policy

The key guiding documents which would inform the amendments of the urban stormwater management policy is the IDP and stormwater By-Law. This is a medium-term project with the responsible party being the Roads and Stormwater Management Department. The funding of this project would also fall under the responsibility of local government (Table 5.2).

5.3.5 Amendments to By-laws

Amendments of by-laws takes place within municipal government and is a medium-term implementation strategy. Funding would also form part of the responsibility of local government (Table 5.2).

5.4 Conclusion

This chapter has explored the implementation process needed to ensure a more water-sensitive Oranjezicht. The implementation followed the key strategies of reverence, education and practice. The goal of the implementation of the proposed interventions is to improve the water-culture within Oranjezicht and eventually, Cape Town's CBD. The implementation of spatial interventions will require collaboration between various departments within municipal government as well as between government and tertiary education institutions. Due to the small scale of the site, most of the policy interventions fall under the responsibility of local government or institutions. These policies would however have an impact beyond the boundaries of Oranjezich and Deer Park.

Table 5.3: Summary of the implementation of non-spatial strategies (author's own)

Project	Guiding Policies & Legislation	Responsible Parties (Existing Institutions & Actors)	Timeframe	Funding
Policy Interventions				
Water Reverence Report	• National Water Act (36 of 1998) • National Water Services Act (108 of 1997) • Integrated Development Plan • CoCT Social Development Strategy • CoCT Spatial Development Framework (CTSDF) • Table Bay District Spatial Development Plan	• **CoCT Department of Water and Sanitation** • **CoCT Department Spatial Planning** • **Tertiary Education Institutions in Cape Town** • City of Cape Town (CoCT) • Water Related NGOs & CBOs • Cape Town Partnership • Central City Improvement District	Short-term: 0- 5 years	• City of Cape Town Municipality • Public & Private Partnerships
Localised Integrated Water Care Framework	• Municipal Systems Act (32 of 2000) • National Water Act (36 of 1998) • National Water Services act (108 of 1997) • Municipal Planning By-Law • Water By-Law • Integrated Development Plan • CTSDF • District Spatial Development Plan	• **CoCT Department of Water and Sanitation** • **Tertiary Education Institutions in Cape Town** • **Department of Environmental Affairs & Development Planning** • CoCT Urban Integration Department • Transport for Cape Town (TCT): Roads & Stormwater Department • Cape Town • Water Related NGOs & CBOs • Cape Town Partnership • Central City Improvement District	Short-term: 0- 5 years	• CoCT Department of Water and Sanitation
Water Planning in Education	• Basic Education Laws Amendment Act (15 of 2011) • Higher Education Amendment Act (39 of 2008) • CoCT Social Development Strategy	• **CoCT Department of Water & Sanitation** • **University of Cape Town** • **Cape Peninsula University of Technology** • Department of Basic Education • Department of Higher Education • Western Cape Education Department • Department of Environmental Affairs & Development Planning • CoCT Urban Integration Department • CoCT Social Development and Early Childhood Development Directorate • Transport for Cape Town (TCT): Roads & Stormwater Department • SANParks • Oranjezicht Rate Payers Association	Long term: 10-15 years	• City of Cape Town • SANParks
Amendments to Management of Urban Stormwater Impacts Policy	• Integrated Development Plan • Stormwater By-Law	• **TCT: Roads & Stormwater Department** • CoCT Department of Water & Sanitation • CoCT's Spatial Planning Department	Medium term: 5 - 10 years	• CoCT Department of Water & Sanitation • TCT: Roads & Stormwater Department
Amendments to By-Laws	• CoCT Stormwater By-Law	• **City of Cape Town**	Medium term: 5 - 10 years	• CoCT Department of Water & Sanitation • TCT: Roads & Stormwater Department

*Key actors are bold at the top of the list

Chapter 6

6 Conclusion

This research project uses Oranjezicht as a study area to identify the ways in which spatial planning could enable and support a more water-sensitive suburb, regarding socio-ecological relationships, attitudes and practices. Urban areas are the highest consumers of water therefore making urban water-culture increasingly important due to the global effects of climate change.

This research project set out to investigate the potential of the Platteklip and Stream, in improving the anthropological consciousness through the implementation of blue-green infrastructural mechanisms to be more inclusive of water and improve water-cognizance. It also promoted improved management of water and water resources by increased collaboration between and within governmental and non-governmental institutions.

The literature review (chapter 2) situates the possibility of an improved water culture within international debates. The review looks at the global attitude around water within the spheres of water management and spatial planning. The review also looks at literature relating to sustainable development and water management to formulate ideas around the shift towards sustainable urban water planning.

Chapter three, the contextual analysis, investigates the status quo of Oranjezicht and Deer park. Key opportunities within the area lies in the open spaces, minimally used water sources, dams and springs. The fact that these opportunities lie within a well-located, high-income suburb also proves to be an opportunity for socio-environmental justice.

The spatial and policy interventions discussed in chapter 4 is an indication of the role planners could play in the conscientizing of urban water-culture. This chapter shows that the site is well suited to become a water hub. This will be done using the strategies of reverence, education and practice within the identifies precincts. Chapter five then moves on to discuss the spatial and policy implementation of these interventions. The key element to the

achieving a positive change in the water-culture within Oranjezicht and surrounding areas is through education and collaboration on the social and political levels.

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